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Bulletin 66

A MONOGRAPHIC REVISION OF THE TWISTED WINGED INSECTS COMPRISING THE ORDER STREPSIPTERA KIRBY

BY

W. DWIGHT PIERCE
Of the Bureau of Entomology, U. S. Department of Agriculture

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BULLETIN OF THE UNITED STATES NATIONAL MUSEUM.

ISSUED DECEMBER 6, 1909.

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This work forms No. 66 of the Bulletin series.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as bulletins.

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Richard Rathbun,
Assistant Secretary, Smithsonian Institution,
In Charge of the United States National Museum.

Washington, U. S. A., *October 30, 1909.*

PREFACE.

The preparation of a monograph of the Strepsiptera received its first impetus in 1903, when Mr. J. C. Crawford collected the type of *Crawfordia pulvinipes.* At that time I was engaged in a study of the habits of the Coleopterous family Rhipiphoridæ. The published statements of the similarity of the so-called "Stylopidæ" and Rhipiphoridæ led me to look into the literature immediately, and almost my first discovery was that the Strepsiptera or "Stylopidæ" were not Coleopterous.

A search through the Hymenopterous collections at the University of Nebraska gave good results, for several species were discovered. The check lists only gave two species to the United States. It was therefore with considerable zeal that I continued the work of investigating the group while at Agricultural College, Mississippi, in 1904, and later at the laboratories of the Southern Field Crop Insect Investigations of the Bureau of Entomology in Texas and at the U. S. National Museum and various libraries of Washington.

This bulletin has been gradually taking its present form since 1906, and was finally submitted for publication, through Dr. L. O. Howard, on March 1, 1909.

W. Dwight Pierce.

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A MONOGRAPHIC REVISION OF THE TWISTED WINGED INSECTS COMPRISING THE ORDER STREPSIPTERA KIRBY.

By W. Dwight Pierce,
Bureau of Entomology, U. S. Department of Agriculture.

INTRODUCTION.

The writer presents, in monographic form, a grouping of the most important facts recorded concerning the insects of the order Strepsiptera Kirby, often known as the coleopterous family Stylopidæ Kirby, together with considerable new material bearing upon the classification, structure, and habits of the order. The manuscript has been completed up to March 1, 1909.

The importance of a more intensive and extensive study of the Strepsiptera is made manifest by a perusal of the large list of host species, among which are already recorded at least twenty-eight injurious species. The group is entirely composed of parasitic insects, and the insidious nature of their attack, which in few cases inconveniences the host, renders detection difficult. It is desired that this article may be the forerunner of much valuable information concerning them.

It is of great importance for interested students throughout the world to make themselves known to each other, in order that together they may hasten the understanding of these parasites, and also that in future publications the scattered notes, published and unpublished, from all lands may be brought together to form a more complete knowledge of their biology and structure.

ACKNOWLEDGMENTS.

The writer's personal acknowledgments are due to the U. S. National Museum and its entomological corps for their courtesy in according all possible facilities for the study of material there deposited and in accepting for publication this article; to Dr. L. O. Howard and Mr. W. D. Hunter for their assistance in facilitating the work; to Mr. E. A. Schwarz and to the late Dr. W. H. Ashmead for valuable suggestions and aid; to Prof. Lawrence Bruner in permitting the writer to extract all material from the collections of the University of Nebraska for study and to deposit all type material in the U. S. National Museum; to Mr. J. C. Crawford for very valuable aid throughout the entire work; to Dr. Henry Skinner for his courtesy in lending material from the Philadelphia Academy of Sciences; and to Mr. Charles T. Brues, Mr. Charles Dury, Mr. Henry L. Viereck, Dr. Sigmund Graenicher, Mr. Fred C. Bowditch, Miss Annette F. Braun, and Dr. A. Fenyes for the kind loan or donation of specimens and notes, and to Mr. Fred C. Bishopp, Mr. Charles R. Jones, Mr. F. C. Pratt, Mr. W. A. Hooker, and Mr. R. A. Cushman, the author's associates, for their zeal in procuring stylopized material for breeding and examination; and finally to Mr. Karl Hofeneder, of Innsbruck, Austria, for valuable assistance during the past two or three months.

COMMON NAMES FOR STREPSIPTERA.

In order to accustom the readers to the many common names used in referring to this order the following list has been compiled. The strictly Latin names for the group may be found by reference to the synonymy preceding the characterization of the order. The greater part of these names mean "twisted-winged;" hence we may call them the twisted-winged parasites.

English and American writers use the nouns "strepsipter," "strepsipteran," "stylops," "stylopid," "rhipipter," "rhipipteran," and the adjectives "strepsipteral," "strepsipteran," "strepsipterous," "stylopid," "rhipidopterous," "rhipipteran," "rhipipterous," and speak of the host as being "stylopized." In Spanish the insects are known as "estrepsipteros," or "ripipteros." German writers use the terms "fächerflügler," "kolbenflügler," "rhipidopteron," "schmarotzende," "schraubenflügler," "strepsipteren," and "stylopiden," and speak of *Xenos* as "die Immenbreme." They speak of a host as "stylopisirt." The triungulinid is known as the "schmarotzerthierchen." French writers generally speak of the "strepsipteres," "rhipipteres," or "rhipidopteres," and call the host "stylopisé." In Scandinavian works are found the terms "strepsiptererne," and "viftevingedes." In Russian works the group is known as "вѣерокрілбіхъ."

HISTORY.

The anomalous character of the Strepsiptera has led in the past to a great shifting of the groups from one place to another in the systems of classification. Rossi in the eighteenth century and Kirby in the first years of the nineteenth century each described a queer and entirely anomalous insect, seemingly without connecting links with any known forms. It was not until Kirby saw Professor Peck's new species (*Xenos peckii*) and heard of Rossi's description that it occurred to him that they belonged together and constituted the nucleus of a new order.

Kirby's decision was not to be received by even the majority for many years and is still rejected by many good authorities. Indeed, two authors writing in the same period seldom placed the group in the same place. It was given two distinct ordinal names—Strepsiptera and Rhipiptera (also spelled Rhiphiptera); it was placed in the Diptera as Rhipidoptera, and Phthiromyiæ, in the Neuroptera as Stylopidæ near the Phryganeidæ, in Hymenoptera near Ichneumon, but most generally in the Coleoptera as Stylopidæ at the end of the Heteromera. Westwood placed them between Hymenoptera and Lepidoptera; Hoeven placed them between Suctoria and Diptera; Menzel referred them to the Diptera (Müller, 1872).

A casual analysis of the placing of the order will reveal the fact that the careful systematists of the Continent soon recognized the ordinal nature of the Strepsiptera and have consistently maintained their views, while, on the other hand, the biologists and systematists of England and America have until recently classified the group as Stylopidæ, coleopterous. It may be said now, however, that the majority of American entomologists consider these insects as meriting full ordinal distinction. Six recent articles on the phylogeny and classification of Insecta, by Handlirsch (1903, 1904), Klapalek (1904), Boerner (1904), Sharp (1899), and Shipley (1904), place the Strepsiptera as an independent order, although all place it next to Coleoptera, Handlirsch holding it to be an offshot during the Tertiary age. In this article it is intended to summarize all of the arguments used on both sides and to show how the balance stands.

The three most recent classifications of the Coleoptera, by Lameere (1900), Kolbe (1901), and Ganglbauer (1903), are not unanimous with regard to the placing of the Strepsiptera. Lameere incorporated the group as a subfamily Stylopinæ in the family Melandryidæ, while Kolbe and Ganglbauer excluded the group entirely from the order. Lameere, later, in an answer to Ganglbauer, does not defend his placing of these insects, so it may be concluded that the opinion of these three authors is unanimous.

The writer in personal correspondence and conversation finds a great diversity of opinion. H. F. Friese, of Germany, and R. C. L. Perkins, of Hawaii, both experienced in the study of the group, incline toward retaining them in the Coleoptera. Dr. Filippo Silvestri, of Italy, who is a student of the Rhipiphoridæ, thinks them related to these beetles. Charles T. Brues, of Milwaukee, finds more evidence for separating them than for placing them with the Coleoptera. Charles Dury, of Cincinnati, desires to consider them Coleoptera, as a matter of sentiment. E. A. Schwarz, the coleopterist, considers the group a distinct order, and so did the late W. H. Ashmead, hymenopterist. Doctor Ashmead believed that there was some connection with the Dermoptera. Frederick Knab has shown the author that there is no resemblance to *Rhipidius*, the blattid parasite.

SYSTEMATIC POSITION.

Although for the past forty years the majority of English and American writers have placed these parasites in the Coleoptera, they seem to have done so without regard to the many good arguments and proofs brought forward on the Continent, which would place them as an independent order.

Before entering into a discussion of the fallacies which have crept into various classifications, or of proving the position of the group, the writer desires to lay emphasis upon the excellent rules for forming an order (in Insecta) as set down by Kirby (1813). These rules seem still to be perfectly valid:

> Rule I. *When an insect in its perfect state combines the characters of two or more orders (unless it be deemed advisable to place it in an order by itself), it should arrange with those whose metamorphosis is the same.*
>
> Rule II. *When an insect possesses the characters of one order and the metamorphosis of another, in this case it should follow the characters.*

On this rule it may be observed that, since the perfect state is the grand consummation of the insect to which all other states are subordinate and subserve, this state therefore ought to be the principal regulator of its station.

> Rule III. *Where an insect exhibits the metamorphosis of an order, or of a section of it but none of its characters, nor those of any other order, it should not on that account be arranged in such order, but, on the contrary, form a distinct one.*
>
> Rule IV. *Where the genera which compose an order have invariably one kind of metamorphosis, no insects that vary from it in that circumstance should be placed in it, unless they exhibit a perfect agreement with it in characters.*

Kirby after formulating his rules proceeded to apply them to the Strepsiptera, and as many of his points are excellent they have been used by the writer as the framework for the following paragraphs.

Metamorphosis, though not the regulating character, nevertheless is one of the most prominent of all ordinal characters. There are a very few types of metamorphosis, but the Strepsiptera stand alone as typifying a life history, the most complex of all. They are invariably hypermetamorphic, and endoparasitic throughout life, the only free stages being the hexapod triungulinids or first larvæ and the adult winged males, and in neither of these stages are they known to take food. The metamorphosis begins with the larviparous production of free living young, which are conveyed by various means to the larvæ of their future hosts. These hexapods after beginning the parasitic existence distend and become grub like, and each succeeding molt makes the females more degenerate, while the males undergo a transformation of specialization. Alimentation seems to be by osmosis or absorption only and at the expense of the vitality of the host, although not fatal. Both sexes exsert the head and thorax from the abdomen of the host, and the two succeeding stages occur without casting the skin.

This type of metamorphosis is unique among insects as in no other case is there complete endoparasitism. In the Meloidæ and Rhipiphoridæ a similar hypermetamorphosis is found, in that the first larvæ are hexapods and the succeeding stages are progressively more degenerate until the pupal stage. But these beetles are not larviparous and their larval development differs as follows: The meloid larvæ are successively campodeoid, carabidoid, scarabæidoid, and coarctate. The strepsipterous larvæ are first campodeoid, and from then undergo a constant and gradual change of habitus, assuming forms utterly unlike anything in the Coleoptera and more resembling the straight appendageless larvæ of certain Diptera. The pupa resembles the vespid pupæ more closely than it does the coleopterous. The retention of the pupa within the larval skin is paralleled in the Diptera, as well as in the Coleoptera.

The primary character in the classification of insects is the consideration of elytra and wings. The Strepsiptera fall with the elytrophorous two-winged orders, but differ in that the elytra or balancers are located more laterally and that they were never expected to act as protections to the wings, for, in fact, the elytra of the Tertiary genus *Mengea* were as rudimentary as those of existing forms. The wings are inserted at a greater distance from the elytra than in any of the other elytrophorous orders, and in shape resemble those of the Orthoptera, being almost a quadrant of a circle, while those of the Coleoptera are semicordate or semiovate. They fold longitudinally as in the Orthoptera and Vespoidea, and as in *Macrosiagon* and *Myodites* in the Coleoptera (Rhipiphoridæ), while this latter order otherwise commonly exhibits an oblique fold at the base and a transverse fold in the middle or beyond. The veining is very simple and radial, paralleled only by *Myodites* in Coleoptera.

The mouth parts are peculiar. They are not used for feeding in the adult, but may be classed with the mandibulates. Labrum and labium are absent and the maxillæ are reduced. The pharynx exposes a broad flared surface, unprotected by any of the usual coverings. The occiput remains. The mandibles are used by the triungulinid to effect an entrance into the body of the host and by the grown larva to cut its way through the abdominal teguments of the adult host. The maxillæ function possibly as sensory appendages.

Finally, a character which has been little used, but which seems to be of much value, may be used to show the wide gap separating the Strepsiptera from the orders with which it has been placed. It is that of the development of head and thorax and the agglutination of these parts, proposed in concrete form by John B. Smith (1899).

He presents a not altogether new table of the orders, which more normally represents the morphological relationships of the orders than any classification yet seen by the writer. In this table he divides the mandibulate orders into three parallel groups:

1. Prothorax mobile; head not free.
2. Prothorax immobile, well developed; head free, not on distinct neck.
3. Prothorax immobile, reduced; head on distinct neck.

The Coleoptera belong in the first, and the Hymenoptera and Diptera in the third.

Probably a more normal grouping of the essentially mandibulate orders would be as follows:

EXOPTERYGOTA, HEMIMETABOLA.

1. All thoracic segments subequal, not agglutinate; wings arising externally; head free, not on a distinct neck.
2. Thoracic segments subequal, meso- and metathorax agglutinate, prothorax free; wings arising externally; head not on distinct neck.
3. Thoracic segments unequal, agglutinate, prothorax reduced; wings arising externally, head free, on distinct neck.

ENDOPTERYGOTA, HOLOMETABOLA.

4. Thoracic segments subequal, meso- and metathorax agglutinate, prothorax free; wings arising internally; head not on distinct neck.
5. Thoracic segments unequal, not agglutinate, prothorax reduced, metathorax greatly developed; wings arising internally; head free, on distinct neck.
6. Thoracic segments unequal, agglutinate, prothorax reduced, metathorax greatly developed; wings arising internally; head free, on distinct neck.

In the first of these groups fall Isoptera, Mallophaga, Corrodentia. In the second fall Orthoptera and Plecoptera, also Thysanoptera. In the third fall Odonata and Ephemeroptera. In the fourth falls Coleoptera; in the fifth the Strepsiptera; in the sixth the Neuroptera, Trichoptera, Mecoptera, Lepidoptera, Diptera, and Hymenoptera. The orders are here used in the Comstockian sense, although the writer is disposed to regard the groupings of Handlirsch and Boerner as more nearly correct. It is not the function of this article to erect a classification of the Hexapoda.

In preparing this grouping, the division by Sharp of the pterygote insects into Exopterygota and Endopterygota (Sharp, 1899) suggested a better outline than could have been gained from Smith alone.

Handlirsch (1903 and 1904) and Boerner (1904) have gone extensively into the phylogeny of insects, and as a result of their work a fifth rule may well be added to Kirby's:

Rule V. *When insects formerly placed arbitrarily in some of the older orders are found by paleontology to be of a distinct line of descent from the order with which they have been ranked, and show decided differences from this order in structure or in metamorphosis, they should be separated out to form a new order.*

In converse also: *Insects which should be separated from an older order in accordance with any of the preceding rules, and yet which show a common origin, must also constitute a separate order.*

Mengea tertiaria, the only fossil insect yet found in the Strepsiptera, shows a nearer approach to other orders than any existent forms except the very recently discovered *Trioxocera mexicana*, in that the tarsi are five-jointed and two-clawed, but in other respects its characters are essentially different from those of any contemporary group, and indicate that the Strepsiptera have completely separated from whatever lineage they formerly belonged to.

Besides being isolated from all other orders by their morphology, and by phylogeny, they may also be shown to be separated by the anatomy of the alimentary, nervous, and reproductive systems at least, by their embryogeny, and by their biology (metamorphosis and reproduction).

Following may be considered some of the principal characteristics of the group upon which authors have based their conclusions that it is worthy of a distinct ordinal name. The authority for each point and the species studied are placed in parenthesis.

1. The order became separated from its nearest related group in or before the Tertiary age (Pierce, *Mengea tertiaria* Menge).
2. Absence of labrum in male and female; very feeble development of maxillæ in male and complete absence in female (Nassonow, 1892 *d*, *Xenos vesparum* Rossi (*rossii* Kirby).
3. Position of mouth opening (referring to the constricted part of the pharynx of the male) in the male and female at comparatively considerable distances from the mouth parts (Nassonow, 1892 *d*, *Xenos vesparum* Rossi). (See pl. 5, fig. 11.)
4. Antennal surface covered with an immense number of elevated sensory organs (Pierce, *Crawfordia pulvinipes*, *Acroschismus pallidus*, *pecosensis*, *bowditchi*, *hubbardi*).
5. Modification of anterior wings of males into club-like balancers (Nassonow, 1892 *d*). (See pl. 6, fig 7.)
6. Reduction of prothorax, sometimes to a mere cylinder surrounded by the mesothorax (Pierce, *Anthericomma barberi*). (See pl. 14, fig. 5.)
7. Unusual development of metathorax and the great distance between the last two pairs of legs. (See pl. 6, fig. 6.)

8. Freedom of movement of head and thoracic segments secured by elastic membranes (Pierce, *Acroschismus pallidus* Brues). (See pl. 5, fig. 7.)

9. The occasional presence of a mesostigmatal protecting lobe (Pierce, *Acroschismus* species). (See pl. 5, fig. 4.)

10. *a*, Wings in form of quadrant, folding longitudinally, veins radial. (See pl. 1, fig. 2.) *b*, The movement of wings and elytra in unison, as contrasted with the stationary character of coleopterous elytra during flight.

11. The permanent exsertion of the male genital organ (œdeagus), and the entire absence of female external genital organs (Pierce, *Crawfordia pulvinipes*, *Acroschismus* species, *Apractelytra schwarzi;* Perkins, 1905, *Halictophagus?* species, *Elenchus* species). (See pl. 2, fig. 6.)

12. Isolation of posterior and middle intestines in male and absence of latter in female (Nassonow, 1892 *d*, *Xenos vesparum* Rossi).

13. Nervous system formed of three ganglia, supraœsophageal, thoracic and ventral (Nassonow, 1892 *d*, *Xenos vesparum* Rossi). (See fig. 2, Nos. 14–17, p. 60.)

14. Absence of Malpighian vessels and cutaneous glands in male and female (Nassonow, 1892 *d*, *Xenos vesparum* Rossi).

15. Presence of unpaired sexual canals on the second to fourth, fifth, or sixth abdominal segments of the female, in the form of curved tubes, resembling the segmental organs of annelids (Nassonow, 1892 *d*, *Xenos vesparum* Rossi, 1893 *a*, *Stylops mellittæ* Nassonow not Kirby; Muir, 1906, *Elenchus tenuicornis* Muir not Kirby.)

16. Absence of ovaries (Nassonow, 1892 *d*, *Xenos vesparum* Rossi). The simultaneous development of all eggs (Brues, 1903, *Xenos peckii* Brues not Kirby).

17. The retention of the female in its unshed pupal skin (Meinert, 1896; Pierce, numerous species).

18. Two pupal instars and the retention of the puparium and first pupal skins by the second male pupa (Pierce, *Acroschismus pallidus*, *pecosensis*).

19. The fusion of head and thoracic segments to form a cephalothorax in the adult female (Nassonow, 1892 *d*, *Xenos vesparum* Rossi; Pierce, *Acroschismus pallidus* Brues).

20. Larviparous reproduction.

21. Hypermetamorphosis.

22. Permanent parasitism of female.

23. Fertilization probably by releasing spermozoa in the buccal cavity or else in the opening of the brood canal.

In rebuttal it may be advisable to show the fallacies of the classifications which called the Strepsiptera coleopterous.

Saunders (1872), following Schaum, and Lacordaire (1859) gave the following as the principal reasons for ranking the Strepsiptera as Stylopidæ, coleopterous:

1. Similarity of hexapod larvæ to those of Meloidæ (and Rhipiphoridæ).

2. "Metamorphosis nearer to that of Coleoptera" than of any other "elytrophorus order" (quoted from Kirby, 1813).

3. Same buccal organs in hexapod larvæ notwithstanding the differences of their respective habits.

4. Variation of buccal organs during metamorphosis of *Sitaris*, as great as differences between these organs in Stylopidæ and in Meloidæ.

5. Participation with several abnormal coleopterous groups in the divergence from conventional formularies of organization and distinguished by the same parasitic associations.

a. *Myodites*, having rudimentary elytra and radial wing venation.

b. *Macrosiagon*, *Myodites*, in the longitudinal folding of the wings.

c. *Rhipidius*, in the eyeless, apterous females.

d. With the males of all these in the highly developed ramose antennæ.

e. With *Meloe*, *Sitaris*, *Zonitis*, in the remarkable coarctate pupal metamorphosis and preliminary transformations.

In the appendix of the present article will be found a discussion of the fallacy of using such characters to bring together unallied groups. As to the metamorphosis, Mr. E. A. Schwarz says that it was probably reached by a line of development parallel with that of the Rhipiphoridæ, due to somewhat similar parasitic habits, because, he says, the Strepsiptera have "nothing in common with the Coleoptera."

The resemblance of the triungulinids of the two families Meloidæ and Rhipiphoridæ and the Strepsiptera is mainly superficial. The meloid hexapods have three claws on the tarsi; the rhipiphorid hexapods have one claw only and a sucker-like pulvillus, and are also provided with a caudal sucker; the strepsipterous hexapods have no tarsal claws, but do have the pulvilli, and instead of the anal sucker are provided with long bristles.

Since the Thysanura are probably the nearest approach to the primitive insects, it is reasonable to expect that where parasitic habits have brought about a hypermetamorphic type of development, the first stages should revert to the primitive Campodeoid type and that distant groups with similar habits should exhibit similar forms in these first stages.

The only genera in the Coleoptera which have been considered close to the stylopids are *Hornia* and *Leonidea* in the Meloidæ and *Rhipidius sens latum*, in the Rhipiphoridæ. The two former are very dissimilar in appearance, and the females have legs. The Rhipidiini differ in that the larvæ leave the host to pupate; the females are like the males, but wingless and with 11-jointed filiform antennæ. According to Mr. Frederick Knab the females also have eyes, legs, and a well-developed ovipositor. Thus it will be seen that there is no resemblance whatever to the Strepsiptera.

The very recent description by Dr. Filippo Silvestri of a female hypermetamorphic insect known as *Rhyzostylops inquirendus*, adds one more genus to those closely similar forms. This female has legs which are very simple in structure, is provided with short, simple antennæ, and lacks all but two pair of mouth parts, the pharynx being exposed, due to the absence of labrum and labium. There are no rudiments of wings; the abdomen is 10-jointed. The insect was found dead under shale or "tufa" at the side of its cluster of eggs. From the eggs, triungulinids were obtained. These had two tarsal claws and posteriorly were armed with stylets. In only two instances are there any resemblances to the Strepsiptera; namely, the rudimentary mouth parts of the adult and the possession of anal stylets by the triungulinid. The insect is anomalous and may or may not belong in the Rhipiphoridæ. If it does, it forms a new tribe below the Rhipidiini. The larva forms a new step in the series of first larvæ by having two tarsal claws.

In all coleopterous classifications containing the Stylopidæ they are arranged at the end of the Heteromera. As LeConte and Horn (1883) are the best authorities in the English language on the Coleoptera, the fallacy of thus locating the Strepsiptera may best be illustrated from their work. In subdividing the Coleoptera they define Isomera as "having the hind tarsi with the same number of joints at least as the others," and Heteromera as having the "front and middle tarsi 5-, hind tarsi 4-jointed." They place Stylopidæ with Heteromera, while they obviously would have to fall in Isomera if they belonged in the Coleoptera. It must be remembered that the Strepsiptera present four types of isomerous tarsi. The sole reason they had for placing the group in Heteromera was to place them at the end of a series of parasites with somewhat similar metamorphosis and other parallel characters as Saunders, Schaum, and Lacordaire had done.

Since the Strepsiptera are isomerous and the Rhipiphoridæ are heteromerous, it is evident that they belong to distinct lines of descent, which has been pointed out as probable. Being separated thus from the Rhipiphoridæ there is no coleopterous group with which they can possibly be allied.

In conclusion, then, the writer would place the Strepsiptera as a separate order, on a distinct line of descent from that of the Coleoptera, and nearer the Hymenoptera and Diptera, and as highly specialized as the highest insects in any of the orders.

The thoracic structure places the order near these other two because of the great development of the metathorax and the extreme reduction of the prothorax and mesothorax. It differs by having the parts not agglutinate except in the female and immature stages.

The mouth structure, consisting of mandibles and maxillæ, but not constructed for feeding on solid food, also draws the Strepsiptera away from the Coleoptera, toward the Hymenoptera.

The nervous system is reduced to a supraœsophageal, a thoracic, and a ventral ganglion from which nerves branch out to all of the segments. Such reduction is frequently found in the Diptera.

The larviparous reproduction is found in the Diptera, but not in the Coleoptera.

COLLECTION.

The building up of a large collection of stylopids is necessarily attended with great painstaking, for only occasional results can possibly attend indiscriminate collecting, but a systematic biological study must yield astonishing results. Furthermore, the work must henceforth be conducted in four orders—Orthoptera, Homoptera, Heteroptera, and Hymenoptera.

In Orthoptera (in the American sense) it is probable that the Blattoidea and Grylloidea will be the only groups parasitized. These insects inhabit damp places and frequently construct burrows. Parasites must be sought in the haunts of the hosts.

The only heteropteron known to be parasitized is a large scutellarid from the Orient. Very possibly more extensive examination in tropical regions will bring out other hosts.

At the present writing the most important order parasitized is the Homoptera. Perkins (1905) has recorded parasites in the Asiracidæ, Issidæ, and Tetigoniidæ, and says that they are sometimes quite abundant. This, then, opens a new field for the economic entomologists. Although it is possible to collect parasites by beating in the grass as Templeton (1838) did when he took *Elenchus tenuicornis*, the best method must be to follow in the steps of Koebele and Perkins (Perkins, 1905) and breed the parasites in breeding cages. The same method will hold with Heteroptera. Mr. Koebele for several years has been endeavoring to introduce American, Vitian (Fijian), and Australian Elenchidæ into Hawaii as parasites of the injurious cane leaf-hoppers. The method used was to collect parasitized Homoptera in large quantities and ship them in cages with a mesh fine enough to prevent the leaf-hoppers from escaping. This mesh would give plenty of room for the triungulinids to get out and attack other hosts. Up to date no success has been recorded in this attempt; in fact, there seems to be no chance of success. Probably the reasons are that the Hawaiian leaf-hoppers are different species or genera and the parasites will not change their host relations.

The collecting and study of the hymenopterous parasites is by no means as difficult or as exacting a work as that with homopterous parasites. The hosts in this order belong to the families Formicidæ in Formicoidea; Eumenidæ, Vespidæ, and Masaridæ in the Vespoidea; Sphecidæ, Stizidæ, and Bembecidæ in the Sphecoidea; and Anthophoridæ, Panurgidæ, Andrenidæ, and Prosopidæ in the Apoidea. These families include social ants, social wasps, solitary wasps, digger bees, gall-dwelling bees, and stem-dwelling bees.

The Hymenoptera campaign should consist of several features: 1. A systematic search of all flowers blooming in the locality studied at all times of the year. 2. A careful record of the host plant, time of appearance and disappearance of each species of bee and wasp. 3. A systematic search for the dwellings of the bees and wasps and sweeping in their vicinity. 4. A study of the interior conditions of the dwellings of each species. 5. Studies of ants' nests.

On the other hand, a systematic study of the Strepsiptera must also yield to the world—

1. A fuller knowledge of the biology of the host insects.
2. An increase in the knowledge of inter-relationships of insects.
3. An addition to the recorded knowledge of the other parasites of the same hosts (as, for instance, Rhipiphoridæ, Meloidæ, Braulidæ, etc.).

The collection of males on the wing would seem to be attended by considerable difficulties, because of the rapidity of flight and the minute size of the insects. The best results must come from breeding the hosts. In the study of *Acroschismus pallidus* the writer found a very convenient arrangement in the shape of an ordinary broad lamp chimney. A pasteboard box was arranged as a support in order to keep the globe in one position and yet horizontal. The ends were merely covered with cheese cloth. A wire screen divided the globe into two compartments, in the upper of which were the wasps and into the lower of which the parasites dropped when exhausted. One end was closed by pasteboard with a hole cut in the middle, through which with a dropper sugar or water could be admitted to a pill box placed on the screening. The pasteboard end was covered with a cheese cloth also. It is not advisable to crowd a cage with wasps. They can be admitted through the same hole intended for the food passing. The parasites can be removed with a camel's-hair brush, but the student must take great precautions, as they are so quick of flight.

One of the desiderata in working with Strepsiptera is to get the triungulinids as well as the adult male and female; hence arrangements must be perfected by the student to keep the hosts alive until time for the triungulinids to emerge.

In the preservation of specimens the writer finds it very inadvisable to mount dry, as the specimens invariably shrivel up, and also because so many of the best characters of the Strepsiptera are microscopic.

Hence two very feasible methods may be suggested. Very fine balsam mounts can be made by supporting the cover glass with broken slivers of a glass slide. This prevents the specimen from being crushed. Glass rings serve the same purpose, but are more expensive. If not desired to make permanent mounts, the specimens may be kept in alcohol and examined under a high-power microscope as follows: Glue a glass ring on a slide with some substance unassailable by alcohol, fill the cell with alcohol, and, after placing the specimen in position, carefully slide a cover glass over it. This will give opportunity to use quite a high power on the object and takes but a minute or two to transfer from the bottle to the slide and back again. Slides with permanent cells may be purchased.

BIOLOGY.

The life history of the Strepsiptera is of so much interest that it appears well to introduce the more specialized treatise of the biology by a brief summary of the most important elements in it.

These insects are called in common parlance "stylops," and students, when speaking of a parasitized insect, usually say that it is "stylopized." The "stylops" is known to most collectors only as a disk-like or acarus-like plate protruding from between the abdominal segments of various bees and wasps. Few, indeed, are they who have seen the adult winged males, although most collectors have marveled at the pictures of them. In fact, many a careful collector would never even notice the foreign body in the abdomen of his specimen.

If this disk-like plate is flat the parasite is an adult female, and the part seen is the cephalothorax, a character not appearing in other insects. The part unseen is merely the grub-like white abdomen which often almost fills the body of the host. If instead of a disk the part exserted is the tuberculate rounded end of a cylindrical body the collector may know that he has a male pupa, from which an adult active male will emerge if he keeps the host alive.

With the grub-like female the discussion of the life history may commence. Dissect it out, and you will usually notice that just where it protrudes its cephalothorax there is some kind of firm connection with the body of the host, which sometimes happens to be a tube. These insects draw their nourishment from their host by osmosis, which is the most degraded manner of alimentation. The body of the female is a great sack full of eggs, all of which develop at the same time, and not in ovaries but loose in the body cavity. The real female never sheds its last skin. It has lost all instinct, except that which causes it to force its chitinized cephalothorax out through the abdomen of its host. Yet in spite of this its nervous system is as highly developed as the male's.

The eggs mature within the body cavity, and the young (of which the writer once counted 2,100 to one female) (Pierce, 1904), find exit from the body of the parent through from three to five median canals opening in the 2d to 4th, 5th, or 6th segments (such canals are nowhere else found in Insecta, but occur in the Annelida). They have passed into a larger passage formed between the venter of the female and its uncast pupal skin, in which they pass forward and find exit through a slit between the head and prothorax on the cephalothorax. The female reposes with its venter upward, so when the young come out they crawl all over the body of the host. These young look like the primitive thysanuran *Campodea,* being very lively little hexapods, with two bristles from the caudal end, and with padded, clawless feet. The name given by Chobaut is triungulinid, because of the resemblance to the meloid triungulins.

The triungulinid remains upon the body of the host until it gets a chance to slip off or is brushed off into a nest or flower. In the latter case it waits until another host comes along and takes passage with it, and is carried to a nest finally. When it reaches a nest it hunts around until it finds a larval host, into which it quickly burrows.

Inside its host parasitic life quickly causes it to lose its legs, and the eyes to disappear, and it is soon entirely grub like; then the segments of the head and thorax fuse. The male and female, after the second molt, appear different, the female becoming as just described, while the male becomes cylindrical and in the later stages shows a patch of eyes, resembling the primitive collembolan eye patches but more regular. The anterior portion hardens and is pushed outward, resembling a dipteran pupa case, with tuberculate head and a little cap at the tip of the cylinder. Within this skin a real pupa, like the hymenopterous pupa, forms, and then another pupa forms within this, and finally the adult develops inside of these three skins and emerges by casting the cap from each skin. The adult male is a most peculiar insect with one pair of large, milky white wings, shaped as a quadrant of a circle; with a short transverse head; with large eyes on stalks, composed of many separate hexagonal facets divided by hairy partitions; with antennæ branched and covered with delicate sense organs; with rudimentary mouth parts, and with little paddle-shaped balancers on the mesothorax.

These insects fly like a flash, darting here and there, and with the balancers vibrating in unison with the wings and making quite a loud hum for such little creatures (for the largest known is but a quarter of an inch long). Their sole purpose in life is to fertilize the females, which act is accomplished by setting loose of the semina either in the brood canal or œsophagus of the female. They live but a few hours, five being the longest recorded, with one exception, when Friese had a male *Stylops* live sixty-two hours (Friese, 1893).

RELATIONS TO HOST.

The subject which deals with the relationships of these parasites to their hosts is many sided and complicated, but it certainly contains many points of great interest to the student of parasitism. A division, therefore, into the main groups of relationships will probably make the discussion more coherent. These divisions are:

1. The actual relationships of the host to the parasite.
2. The effects of parasitism upon the individual hosts.
3. The effects of various host conditions upon the parasites.
4. Seasonal conditions and the biology of the hosts as influencing the biology of the parasites.

1. ACTUAL RELATIONSHIP TO THE HOST.

When the young triungulinids leave the body of the parent they find themselves crawling over the body of the parent's host. They are restless for they must reach some new host. The insect, then, which now bears them, and which for convenience will be known hereafter as the maternal host, becomes the first agency of transfer of the minute triungulinids. There are obviously several ways in which the parasites may reach new hosts, and probably all are followed in actual life.

They may be carried direct to the nest of the maternal host, where they may find new hosts immediately. This is especially possible in the case of colonial insects, for there the parasites may pass from one cell to another until a proper host is found. But if the maternal host is a male solitary insect, or if the hosts are not nest builders (in the case of Orthoptera, Homoptera, Heteroptera) then this is not the method of transfer.

It is, however, almost out of the question that the host should carry the triungulinids to its own young, because the observation of Perez that there is a loss of function in parasitized females would indicate that there is no nest building by affected individuals. Perez (1886) looks at the matter in this light: "Il devrait par conséquent exister dans chaque espèce d'abeilles nourissant ces parasites, une lignée, une race exclusivement affectée, à leur entretien, ce que, à priori, est absolument improbable."

They may leave the maternal host at some place frequented by other individuals of the same species. In case of bees this will be a flower of a certain species, which flower or rather plant may be known as the host plant. The opportunities of reaching a new host are many. Among bees all individuals mature during more or less definite periods and frequent a limited number of flower species, although the males may visit several species of flowers not visited by the females. The little triungulinids may be picked up in a mass of pollen, or they may reach this new host, which must be known as a temporary host, by their own volition. Saunders (1853) proved that they have remarkable saltatorial power, which power, together with the aid of the sucker-like pads of the tarsi, will enable them to reach an insect which may pause but a second at the flower. In such manner there may possibly be several temporary hosts in some cases before the triungulinid reaches the nest. In connection with the part the maternal host fulfills in the destiny of the parasite, Newport (1851) makes the significant remark that the bees live long enough to perpetuate the enemies of their race and to serve the young Strepsiptera as a means of transportation to their hosts.

The triungulinids may be forcibly removed by the bee, as was observed by Smith (1859) with regard to *Andrena trimmerana.* He says: "She was covered with hundreds of larvæ of *Stylops* and her brushing and excitement were caused by efforts, on her part, to free herself from the annoyance which the host of larvæ evidently occasioned her."

The writer can now add another link in the chain of evidence which has been produced to strengthen the flower-transfer hypothesis. On July 21, 1906, at Dallas, Texas, Mr. W. A. Hooker collected from *Helenium tenuifolium,* a *Leionotus verus* Cresson containing two female parasites which had produced triungulinids, and also an *Agapostemon texanus* bearing two triungulinids of the identical species on the last ventral segment. Thus it may be seen that the triungulinids are actually left at the host flowers and also that many climb upon the wrong host, just as the writer formerly showed to be the case with the triungulinids of *Myodites solidaginis.*

Perez (1886) suggests that in seeking shelter overnight or in stormy periods in the nests of other individuals, the maternal host or an intermediate carrier may leave triungulinids in position to find permanent hosts.

In case of the social and solitary wasps the places frequented are little puddles of water, posts, and often flowers. In the case of Homoptera the triungulinids are very likely scattered throughout the grass over which the young leaf-hoppers are feeding. With *Gryllotalpa* the agency of transfer must be some damp locality where these insects congregate. The actual transfer agency must at present be a matter of conjecture in all such insects. Suffice it that either the maternal hosts or some temporary hosts transfer the young to the places where they can find their permanent hosts.

The triungulinid immediately attacks its host when it finds the proper one. Saunders (1853) found that *Xenos* larvæ would not attack soft *Polistes* pupæ nor eggs, but that they would burrow immediately into a larva, being completely inside in a space of three hours. He found that triungulinids of *Hylechthrus* were unable to effect an entrance through the pellicle of *Polistes* larvæ.

The parasites do not penetrate the vital organs of the hosts, but adjust themselves between the organs and crowd these out of position or crush them. The nourishment seems to be by osmosis—that is, by absorption of the juices of the host, although this point is not definitely established. Sometimes the number of parasites becomes so great that the host becomes seriously injured and death results.

The location of the parasites in the body of the host is as a general rule indifferent, although the males generally occupy the basal segments and the females the apical segments. These remarks are based primarily upon a study of *Polistes annularis*. A notable exception was found in *Andrena crawfordi*, in 92 parasitized individuals, of which every parasite was located between the fourth and fifth segments.

With Homoptera there seems to be more definite location for the parasites, according to Perkins (1905). He treats this subject as follows:

> It is perhaps worthy of notice that the male puparia of the species of *Halictophagus* (?), parasitic on jassids, pierce the dorsum or even the venter of the abdomen of these leaf-hoppers, but the head of the female is always, or nearly always, thrust through the pleura. On the contrary, in *Elenchus* and *Deinelenchus*, parasitic on fulgorids, the male puparium (as well as the head of the female parasite) is exserted from the pleural region only.
>
> In the case of the Halictophaginæ we found only mature leaf-hoppers to contain mature female parasites and puparia; but in the case of *Elenchus tenuicornis* the nymph or adult delphacids will alike produce mature parasites of either sex.

In the following pages are brought together definite statistics, published and original, on the percentage of infestation of several species and on the location of the parasites in the bodies of the host.

POLISTES ANNULARIS Linnaeus.

At Rosser, Texas, on September 23, 1905, Mr. F. C. Bishopp and Mr. C. R. Jones, both of the U. S. Department of Agriculture, collected two large nests of *Polistes annularis*, abundantly parasitized by *Acroschismus pallidus* Brues.

The nests contained, respectively, 1,575 and 1,212 cells, or a total of 2,787 cells, from which at the time or by subsequent breeding 1,553 wasps were obtained.

On these wasps the following data were obtained, as tabulated:

1,311 male wasps,	1,052 unparasitized,	259 parasitized.
242 female wasps;	235 unparasitized,	7 parasitized.
1,553 wasps;	1,287 unparasitized,	266 parasitized.

84.4 per cent of the wasps were males, 15.6 per cent females.
97.3 per cent of the parasitized wasps were males, 2.7 per cent females.
80.3 per cent of the male wasps were unparasitized, 19.7 per cent parasitized.
97.2 per cent of the female wasps were unparasitized, 2.8 per cent parasitized.
82.8 per cent of all the wasps were unparasitized, 17.2 per cent parasitized.

The following data give more specifically the extent of parasitism found in these wasps, bringing out the percentage of sexes of the parasites and their relations to each other:

1 male wasp with 15 male parasites = 15 parasites.
1 male wasp with 5 male parasites = 5 parasites.
1 male wasp with 4 male parasites = 4 parasites.
6 male wasps with 3 male parasites = 18 parasites.
17 male wasps with 2 male parasites = 34 parasites.
112 male wasps with 1 male parasite = 112 parasites.
—— ——
138 male wasps with 188 male parasites.
4 female wasps with 1 male parasite = 4 parasites.
—— ——
142 wasps with 192 male parasites.

11 male wasps with 2 female parasites = 22 female parasites.
47 male wasps with 1 female parasite = 47 female parasites.
— —
58 male wasps with 69 female parasites.
2 female wasps with 1 female parasite = 2 female parasites.
— —
60 wasps with 71 female parasites.

Parasites.
1 male wasp with 5 male, 2 female (7) parasites = 5 male, 2 female = 7
1 male wasp with 2 male, 5 female (7) parasites = 2 male, 5 female = 7
2 male wasps with 5 male, 1 female (6) parasites = 10 male, 2 female = 12
1 male wasp with 4 male, 2 female (6) parasites = 4 male, 2 female = 6
1 male wasp with 3 male, 3 female (6) parasites = 3 male, 3 female = 6
2 male wasps with 2 male, 4 female (6) parasites = 4 male, 8 female = 12
1 male wasp with 3 male, 2 female (5) parasites = 3 male, 2 female = 5
5 male wasps with 3 male, 1 female (4) parasites = 15 male, 5 female = 20
5 male wasps with 2 male, 2 female (4) parasites = 10 male, 10 female = 20
2 male wasps with 1 male, 3 female (4) parasites = 2 male, 6 female = 27
9 male wasps with 2 male, 1 female (3) parasites = 18 male, 9 female = 27
5 male wasps with 1 male, 2 female (2) parasites = 5 male, 10 female = 15
28 male wasps with 1 male, 1 female (2) parasites = 28 male, 28 female = 56
— —— — ——
63 male wasps with 109 male, 92 female = 201
1 female wasp with 1 male, 1 female (2) parasites = 1 male, 1 female = 2
— —— — ——
64 wasps with 110 male, 93 female = 203

The highest amount of parasitism then in the author's study was 15, which number is exceeded by the record of 31 larvæ in one larval host. (Brues, 1903.)

In summarizing these figures the following totals and percentages are obtained, which bear directly upon the question of survival of the parasites.

138 male wasps with 192 male parasites =192 parasites.
63 male wasps with 109 male, 92 female parasites=201 parasites.
58 male wasps with 69 female parasites= 69 parasites.
— —— —— ——
259 male wasps with 301 male, 161 female parasites=462 parasites.
== == == ==
4 female wasps with 4 male parasites = 4 parasites.
1 female wasp with 1 male, 1 female parasite = 2 parasites.

2 female wasps with		2 female parasites=	2 parasites.
—	—	—	—
7 female wasps with	5 male,	3 female parasites=	8 parasites.
=	=	=	=
266 wasps with	306 male+	164 female parasites=	470 parasites.

65.1 per cent of parasites are males.
34.9 per cent of parasites are females.

Of the 164 female parasites only 71, or 42.6 per cent, occurred in hosts containing no male parasites. Brues (1905) has pointed out that hosts from which male parasites have emerged can not pass through the winter. Furthermore, it seems that few male wasps ever endure the winter season. This reduces the number of females, then, which would have survived to reproduce their species, to 2, or .2 per cent, of the total number of females.

These figures lack one powerful coefficient, however. It is not known how many parasitized female wasps had left the nest at the time it was taken.

The location of the parasites may be summarized as follows:

1 male protruding from the first segment, dorsal; total, 1.
21 males protruding from the second segment, dorsal
5 males protruding from the second segment, ventral } total, 26.
132 males protruding from the third segment, dorsal
14 males protruding from the third segment, ventral } total, 146.
85 males protruding from the fourth segment, dorsal
16 males protruding from the fourth segment, ventral } total, 101.
29 males protruding from the fifth segment, dorsal
1 male protruding from the fifth segment, ventral } total, 30.
2 males protruding from the sixth segment, dorsal; total, 2.
2 females protruding from the third segment, dorsal
2 females protruding from the third segment, ventral } total, 4.
29 females protruding from the fourth segment, dorsal
3 females protruding from the fourth segment, ventral } total, 32.
106 females protruding from the fifth segment, dorsal
9 females protruding from the fifth segment, ventral } total, 115.
10 females protruding from the sixth segment, dorsal; total, 10.

These figures show that the majority of the males protrude from behind the third and fourth segments, while the females mainly find exit behind the fifth segment.

Brues (1905) at Paris, Texas, took in July 36 female wasps, from which he secured 91 male parasites and 3 female parasites; 35 wasps contained males, while 3 wasps contained females. Both sexes were found in only one wasp. On October 3, from 36 female wasps he took 81 male parasites and 44 female parasites; 25 wasps contained males, 27 contained females, 3 contained larvæ; 8 wasps contained males only, 10 contained females only, 17 contained both sexes, and 1 contained a larva only.

At Orlando, Florida, Mr. W. A. Hooker found, on November 28, 1906, 1 dead male wasp which contained 3 male exuvia located in the third dorsal, third ventral, and fourth ventral, and 3 females located in the fourth dorsal, fifth dorsal, and fifth ventral. On December 7 he found in hibernation in a house 60 wasps of which 6 were parasitized. These were females.

2 wasps contained 1 female each.
1 wasp contained 1 female and 1 male exuvium.
1 wasp contained 1 female, 1 exuvium, and 1 puparium.
1 wasp contained 2 females and 2 exuvia.

The location of the parasites in all wasps taken by Mr. Hooker is as follows:

Location.	Dorsal.	Ventral.	Total.
Second segment	1 male	1 male	2 males.
Third segment	3 males	2 males	5 males.
Fourth segment	2 females	1 male	1 male, 2 females.
Fifth segment	6 females	1 female	7 females.

Probably the most interesting feature is the hibernation of wasps containing male exuvia.

At the same place on December 31 Mr. J. C. Crawford took one female containing a male exuvium.

At Plummers Island, Maryland, February 24, 1903, Mr. W. V. Warner collected a female bearing a male exuvium. This is undoubted hibernation with the empty case. At the same place in December, 1906, Mr. H. S. Barber collected 35 hibernating wasps. These were killed January 3, 1907, and 2 were found parasitized by a single female each. The wasps were all females. In November, 1907, Mr. McAtee also collected 10 unparasitized male wasps, 89 unparasitized females, and 6 parasitized females, containing 3 male and 12 female parasites. At the same place on November 9, 1907, Prof. W. P. Hay collected 54 wasps, of which 4 contained 6 parasites in all.

POLISTES GALLICUS Linnaeus.

Rosenhauer (1842) records from 77 wasps 81 male parasites and 44 female parasites; 56 wasps contained males and 32 contained females; 45 wasps contained males only, 21 contained females only, while 11 contained both sexes. Siebold (1843) questions whether Rosenhauer knew the sex of these parasites.

POLISTES, new species, near MINOR.

At Victoria, Texas, September 25, 1906, Mr. J. C. Crawford collected four nests in one tree. Two nests were entirely unparasitized. In one nest 25 female wasps were unparasitized and one male contained a male puparium. The fourth nest contained 133 female and 52 male wasps unparasitized; and 2 females and 3 male wasps parasitized.

At Dallas, Texas, October 11, 1906, Mr. R. A. Cushman and the writer collected two nests. In the first 13 male and 4 female wasps were unparasitized and 1 male was parasitized, while in the second the 9 males and 1 female were all unparasitized.

POLISTES METRICUS Say.

Austin (1882) at Readville, Massachusetts, on August 20, 1879, took *Polistes metricus* parasitized as follows:

14 male wasps taken, 2 parasitized.
36 female wasps taken, 7 parasitized.
1 female wasp contained 7 male parasites.
1 female wasp contained 2 male parasites.
1 female wasp contained 1 male parasite.
1 female wasp contained 1 female parasite.

According to note 3513, U. S. Department of Agriculture, Bureau of Entomology, a specimen of this wasp bearing 8 fully grown females was taken September 4, 1884, near Washington, D. C. Other wasps taken on the same date bore empty puparia.

POLISTES PALLIPES Lepeletier.

At Marion, Massachusetts, on September 2 and 12, 1902, Mr. Fred. C. Bowditch took 10 *Polistes pallipes* parasitized by *Acroschismus bowditchi* Pierce.

Five adult males were bred, and these have been studied by the author. In the 4 male wasps are 16 male pupæ. In the 6 female wasps are 4 female parasites, 1 male pupa, and 9 empty puparia; that is, each male averaged 4 parasites and each female 2.33 parasites. The parasites were in the proportion of 26 males to 4 females, or only 13.3 per cent females. The highest number of parasites to an individual was 10, all pupæ, in a male wasp.

The record of parasitism was thus:

2 female wasps with 1 male, 1 female = 4 parasites.
1 female wasp with 1 male, 2 female = 3 parasites.
1 male, 2 female wasps with 1 male only = 3 parasites.
1 male wasp with 2 male = 2 parasites.
1 male wasp with 3 male = 3 parasites.
1 female wasp with 5 male = 5 parasites.
1 male wasp with 10 male = 10 parasites.
4 male, 6 female wasps with 30 parasites.

The location of the parasites was as follows:

Location.	Dorsal.	Ventral.	Total.
Second segment	3 male		3 male.
Third segment	7 male	5 male	12 male.
Fourth segment	6 male, 2 female	2 male	8 male, 2 female.
Fifth segment	1 male, 2 female	1 male	2 male, 2 female.
Sixth segment	1 male		1 male.

At Cincinnati, Ohio, Mr. Charles Dury took 15 *Polistes pallipes* parasitized by *Acroschismus bowditchi.*

Four adult males were bred, and these have been studied by the author. In the 4 male wasps were 12 male parasites and 1 female parasite. In the 10 female wasps were 23 male parasites and 1 female parasite. In the remaining mutilated specimen was 1 male parasite. Each male, therefore, averaged 3.25 parasites, and each female 2.4 parasites. The parasites were in the proportion of 36 males to 2 females, or only 5.2 per cent females. The highest number of parasites to an individual was 9, all pupæ, in a female wasp. The wasp was so feeble it could hardly move.

The record of parasitism was thus:

					Male pupæ.		Male exuvia.		Parasites.
June 15, 1900:		1 female		wasp with	2				= 2
July 3, 1901:		1 female		wasp with	4				= 4
Aug. 24, 1905:		2 female		wasps with	1				= 2
Aug. 24, 1905:		1 female		wasp with			2		= 2
Aug. 24, 1905:		1 female		wasp with	9				= 9
Aug. 25, 1905:		1 female		wasp with				1 female	= 1
Aug. 25, 1905:		1 female		wasp with	1				= 1
Sept. 13, 1900:	1 male			wasp with			4		= 4
Sept. 16, 1905:			1 ?	wasp with		1 male			= 1
Sept. 16, 1905:	1 male			wasp with		1 male			= 1
Sept. 16, 1905:	1 male			wasp with		1 male		1 female	= 2
Sept. 16, 1905:	1 male			wasp with		1 male	5		= 6
Sept. 22, 1905:		1 female		wasp with	1				= 1
Sept. 27, 1900:		1 female		wasp with			2		= 2
	4 males,	10 females,	1 ?	wasp with	19,	4 males,	13	2 females	=38

The location of the parasites was as follows:

Location.	Dorsal.	Ventral.	Total.
Second segment	3 male		3 male.
Third segment	17 male, 1 female	2 male	19 male, 1 female
Fourth segment	7 male	3 male	10 male.
Fifth segment	1 male, 1 female	3 male	4 male, 1 female.

POLISTES RUBIGINOSUS Lepeletier.

A nest of *Polistes rubiginosus* was collected by Mr. Bishopp and Mr. Jones at Rosser, Texas, September 23, 1905, containing 377 cells; 171 wasps were procured, 137 being males and 34 females. Not one was parasitized. The same gentlemen at Mineola, Texas, July 19, 1906, examined 21 specimens taken at a nest and none were parasitized.

POLISTES TEXANUS Cresson.

Skinner (1903 *a*) cites the capture of two nests of this species at Pecos, Texas, on September 25, 1901, by Mr. A. E. Brown, from which 144 wasps were obtained, 34 being parasitized.

POLISTES VARIATUS Cresson.

On October 18, 1903, Mr. Crawford took at West Point, Nebraska, 200 wasps of this species, all unstylopized, of which only 2 were males.

NECTARINA LECHEGUANA Latreille.

In December, 1905, Mr. A. C. Morgan took a nest of *Nectarina lecheguana* at Hidalgo, Texas, and from this nest Mr. Crawford examined about 2,500 wasps for parasitism without finding a single case. Du Buysson (1905 *a*) states that he has never met a case of stylopization in *Nectarina*.

PROSOPIS, species.

Saunders (1852) took 22 specimens of *Prosopis*, in which he found 32 male and 17 female parasites; 14 bees contained male parasites and 8 contained female parasites. No bee was found containing both sexes.

ANDRENA CRAWFORDI Viereck.

Between April 26, 1906, and May 23, 1906, at Dallas, Texas, a large number of this species of bee were collected by Messrs. Crawford, Bishopp, Jones, Pratt, and the writer from the flowers of *Sitilias caroliniana*, *Serinea oppositifolia*, *Lindheimera texana*, and *Engelmannia pinnatifida*. Following is a table of the captures for the entire period. All parasites were beneath the fourth segment.

151 male bees;	120 unparasitized,	31 parasitized.
115 female bees;	54 unparasitized,	61 parasitized.
266 bees;	174 unparasitized,	92 parasitized.

56.7 per cent of the bees were males, 43.3 per cent females.
33.6 per cent of the parasitized bees were males, 66.4 per cent females.
79.4 per cent of the male bees, unparasitized; 20.6 per cent parasitized.
46.9 per cent of the female bees, unparasitized; 53.1 per cent parasitized.
65.4 per cent of all the bees unparasitized; 34.6 per cent parasitized.

The following table gives more specifically the extent of parasitism, bringing out the percentage of sexes of the parasites and their relation to each other:

	1 female bee	with 3 female parasites	= 3 parasites=		3 females.
1 male,	6 female bees	with 2 female parasites	=14 parasites=		14 females.
23 males,	17 female bees	with 1 female parasite	=40 parasites=		40 females.
7 males,	37 female bees	with 1 male parasite	=44 parasites=	44 males.	
31 males,	61 female bees	with	101 parasites=	44 males,	57 females.

43.5 per cent of all parasites were males.
56.5 per cent of all parasites were females.

ANDRENA LAPPONICA Zetterstadt.

Theobald (1892) gives a few imperfect records of his observations in this species. The collecting was done at St. Leonards-on-Sea, England.

In 1887, 105 bees out of 180 taken were parasitized=52.7 per cent.
In 1888, 54 bees out of 60 taken were parasitized=90.0 per cent.

The following table is based on the collection of 1888:

	2 female bees	with 3 parasites each	= 6 parasites.
3 male,	6 female bees	with 2 parasites each	=18 parasites.
18 male,	25 female bees	with 1 parasite each	=43 parasites.
21 male,	33 female bees with		67 parasites.

ANDRENA NIGROÆNEA Kirby.

Theobald (1892) also gives similar data concerning this species, but does not state the source of his material. He found

1 male,	3 female bees	with 3 parasites each	=12 parasites.
5 male,	3 female bees	with 2 parasites each	=16 parasites.
12 male,	16 female bees	with 1 parasite each	=28 parasites.
18 male,	22 female=40 bees with		56 parasites.

ANDRENA OVINA Klug (PRATENSIS Nylander).

Friese (1883) made numerous records on the parasitism of *Andrena pratensis*. His records tabulated are as follows:

								Parasites.
October 9:	2 female		bees with 1 male		=	2 males		= 2
December 11:		1 male bee	with 1 male		=	1 male		= 1
December 11:		1 male bee	with	1 female	=		1 female	= 1
December 14:	2 female		bees with 1 male		=	2 males		= 2
December 14:		2 male bees	with 2 males		=	4 males		= 4
December 14:	1 female,	1 male bee	with	1 female	=		2 females	= 2
December 14:	1 female		bee with 1 male,	1 female	=	1 male,	1 female	= 2
February 26:	2 female,	3 male bees	with 1 male		=	5 males		= 5
	5 female,	5 male bees	with	1 female	=		10 females	=10
	1 female,	2 male bees	with	2 females	=		6 females	= 6
	2 female		bees with 1 male,	1 female	=	2 males,	2 females	= 4
	1 female		bee with 2 males,	1 female	=	2 males,	1 female	= 3
	17 female,	15 male=32 bees with				19 males,	23 females	=42

In other words, the 15 male bees contained 19 parasites and the 17 female bees contained 23 parasites; 6 male and 6 female bees contained males only, 9 males and 7 female bees contained females only, while 4 female bees contained both sexes.

ANDRENA TIBIALIS (ATRICEPS) Kirby.

Enock (1875) on April 5 and 6 took, on Hampstead Heath, England, 45 stylopized and 27 unstylopized specimens of *Andrena tibialis* (*atriceps*). His records tabulated are as follows:

	1 male bee	with	3 females	=		3 females	= 3 parasites.
	1 male bee	with 1 male,	2 females	=	1 male,	2 females	= 3 parasites.
	1 male bee	with 1 male,	1 female	=	1 male,	1 female	= 2 parasites.
1 female,	6 male bees	with	2 females	=		14 females	=14 parasites.
	2 male bees	with 2 males,		=	4 males		= 4 parasites.
6 female,	14 male bees	with	1 female	=		20 females	=20 parasites.
1 female,	12 male bees	with 1 male		=	13 males		=13 parasites.
8 female,	37 male=45 bees with				19 males,	40 females	=59 parasites.

TETIGONIA, species.

Perkins (1905) cites a pair in copula taken in Hawaii, of which the male bore 2 male pupæ and 2 females, and the female bore 3 or 4 parasites.

The foregoing data may be summarized as follows:

Sex of hosts.

Polistes annularis (Pierce, October), 1,553 wasps; 84.4 per cent males, 15.6 per cent females.
Polistes annularis (Barber, December), 35 wasps; 100 per cent females.
Polistes annularis (McAtee, November), 105 wasps, 9.5 per cent males, 90.5 per cent females.
Polistes, new species (Crawford, September), 216 wasps; 26 per cent males, 74 per cent females.
Polistes, new species (Cushman, October), 28 wasps; 82.2 per cent males, 17.8 per cent females.
Polistes metricus (Austin), 50 wasps; 28 per cent males, 72 per cent females.
Andrena crawfordi (Pierce), 266 bees; 56.7 per cent males, 43.3 per cent females.

Sex of parasitized hosts.

Polistes annularis (Pierce, October), 266 parasitized; 97.3 per cent males, 2.7 per cent females.
Polistes annularis (Hooker, December), 6 parasitized; 100 per cent females.
Polistes annularis (McAtee, November), 6 parasitized; 100 per cent females.
Polistes, new species (Crawford, September), 6 parasitized; 66.6 per cent males, 33.4 per cent females.
Polistes pallipes (Bowditch), 10 parasitized; 40 per cent males, 60 per cent females.
Polistes pallipes (Dury), 14 parasitized; 28.5 per cent males, 71.5 per cent females.
Polistes metricus (Austin), 9 parasitized; 22.2 per cent males, 77.8 per cent females.
Andrena crawfordi (Pierce), 92 parasitized; 33.6 per cent males, 66.4 per cent females.
Andrena lapponica (Theobald), 54 parasitized; 38.8 per cent males, 61.2 per cent females.
Andrena nigroænea (Theobald), 40 parasitized; 45 per cent males, 55 per cent females.
Andrena pratensis (Friese), 32 parasitized; 46.8 per cent males, 53.2 per cent females.
Andrena tibialis (Enock), 45 parasitized; 82.2 per cent males, 17.8 per cent females.

Parasitism of male hosts.

Polistes annularis (Pierce), 1,311 males; 19.7 per cent parasitized.
Polistes, new species (Crawford), 56 males; 7.1 per cent parasitized.
Polistes, new species (Cushman), 23 males; 4.3 per cent parasitized.
Polistes metricus (Austin), 14 males; 14.2 per cent parasitized.
Andrena crawfordi (Pierce) 151 males; 20.6 per cent parasitized.

Parasitism of female hosts.

Polistes annularis (Pierce), 242 females; 2.8 per cent parasitized.
Polistes annularis (Barber), 35 females; 5.7 per cent parasitized.
Polistes annularis (McAtee), 95 females; 6.3 per cent parasitized.
Polistes, new species (Crawford), 160 females; 1.2 per cent parasitized.
Polistes metricus (Austin), 36 females; 19.4 per cent parasitized.
Andrena crawfordi (Pierce), 115 females; 53.1 per cent parasitized.

Percentage of parasitism according to species.

Polistes annularis (Pierce), 1,553 wasps; 17.2 per cent parasitized.
Polistes annularis (Hay), 54 wasps; 7.4 per cent parasitized.
Polistes annularis (Barber), 35 wasps; 5.7 per cent parasitized.
Polistes annularis (McAtee), 105 wasps; 5.7 per cent parasitized.
Polistes new species (Crawford), 216 wasps; 2.7 per cent parasitized.
Polistes, new species (Cushman), 28 wasps; 3.5 per cent parasitized.
Polistes metricus (Austin), 50 wasps; 18 per cent parasitized.
Polistes texanus (Skinner), 144 wasps; 23.6 per cent parasitized.
Andrena crawfordi (Pierce), 266 bees; 34.6 per cent parasitized.
Andrena lapponica (Theobald, 1887), 180 bees; 52.7 per cent parasitized.
Andrena lapponica (Theobald, 1888), 60 bees; 90 per cent parasitized.

Sex of parasites.

Polistes annularis (Pierce, October), 470 parasites; 65.1 per cent males, 34.9 per cent females.
Polistes annularis (Hooker, December), 17 parasites; 47 per cent males, 53 per cent females.
Polistes annularis (McAtee, November); 20 per cent males, 80 per cent females.
Polistes annularis (Brues, July), 94 parasites; 96.7 per cent males, 3.3 per cent females.
Polistes annularis (Brues, October), 125 parasites; 64.8 per cent males, 35.2 per cent females.
Polistes gallicus (Rosenhauer), 125 parasites; 64.8 per cent males, 35.2 per cent females.
Polistes pallipes (Bowditch, September), 30 parasites; 86.6 per cent males, 13.4 per cent females.
Polistes pallipes (Dury), 38 parasites; 94.7 per cent males, 5.3 per cent females.
Prosopis, species (Saunders), 49 parasites; 65.3 per cent males, 34.7 per cent females.
Andrena crawfordi (Pierce, May), 101 parasites; 43.5 per cent males, 56.5 per cent females.
Andrena pratensis (Friese), 42 parasites; 45.2 per cent males, 54.8 per cent females.
Andrena tibialis (Enock, April), 59 parasites; 32.2 per cent males, 67.8 per cent females.

Maximum parasitism per individual.

Polistes annularis (Pierce), 1 male wasp with 15 male parasites.
Polistes annularis (Hooker), 1 male wasp with 3 male, 3 female parasites.
Polistes annularis (Brues), 1 wasp larva with 31 larval parasites.
Polistes metricus (Austin), 1 female wasp with 7 male parasites.
Polistes pallipes (Bowditch), 1 male wasp with 10 male parasites.
Polistes pallipes (Dury), 1 female wasp with 9 male parasites.
Andrena crawfordi (Pierce), 1 female bee with 3 female parasites.
Andrena lapponica (Theobald), 2 female bees with 3 parasites each.
Andrena nigroaenea (Theobald), 3 female, 1 male bee with 3 parasites each.
Andrena pratensis (Friese), 1 female bee with 2 male, 1 female parasite.
Andrena tibialis (Enock), 1 male bee with 3 female parasites.
Andrena tibialis (Enock), 1 male bee with 1 male, 2 female parasites.
Tetigonia, species (Perkins), 1 pair { male leafhopper with 2 male, 2 female parasites.
female leafhopper with 3 or 4 parasites.

In studying these figures, which are gathered under various conditions and by different observers, there are certain conclusions which may be drawn with safety.

1. A large series of observations is always necessary in order to draw valid conclusions. Previous statements that wasps could not

live many days after the exit of the male are now disproven by the hibernation records on *Polistes annularis*.

2. In most cases the largest percentage of parasitized hosts are females. Only a small percentage of the males of any species have been found parasitized. Parasitism of females sometimes becomes very high—53.1 per cent. The highest percentage of, parasitism recorded is 90 per cent for *Andrena lapponica*. Next to this must come *Andrena crawfordi*. Of 145 bees taken between April 26, 1906, and May 2, 1906, 81, or 55 per cent, were parasitized, and of the 65 females, 57, or 87 per cent, were parasitized, while only 24, or 30 per cent of the 80 males were affected. The percentage in *Andrena lapponica* for 1887 is also worthy of note—52.7 per cent of 180 bees.

3. In the majority of cases there are a great many more male than female parasites. The only two exceptions—*A. pratensis* and *A. tibialis*—were winter and early spring records.

4. Male parasites were found in all parts of the hosts' abdomen except the ultimate or genital segments. Female parasites seldom occur before the fourth segment, although they are sometimes found in the third. The third segment is the normal location of the males, and the fifth the normal location of the females. A parasite will find exit any place around the periphery of a segment where it can get sufficient room. According to Perkins (1905) this does not hold in the case of Homopterous hosts.

5. Both sexes of parasites are often found together in the same individual.

6. A host will nourish as many parasites as can find room in its body. The largest number of larval parasites found in a host is 31, while the largest number of male pupæ found exserted from the body of a host is 15. The host in this case (*P. annularis*) lived several days; it was taken with the nest or may have hatched after the nest was captured. Mr. Bowditch took a male *P. pallipes* in the field, bearing 10 male pupæ, and Mr. Dury took a female bearing 9 pupæ, which was so feeble that it could hardly move around. The latter also took a wasp in the field from which 5 males had emerged.

2. EFFECTS OF PARASITISM ON THE HOST.

1. Extermination of race or species.

Although the parasite lives within the body of the host without actually destroying any of its organs, the latter is extremely disabled by the extraction of its body juices through the absorptive power of the parasite. The result is that the host dies without being able to reproduce. When conditions are such that the parasites can not readily be transferred from race to race of hosts, or are by conditions concentrated against the individuals or colonies in a limited locality the possibility is that the race of host and parasites both will become exterminated, the former for the lack of ability to reproduce, the second because of the extermination of their means of livelihood. Theobald (1892) cites the case of *Andrena lapponica*, at St. Leonards-on-Sea. The bees were found in four localities, but extremely local in 1886. In 1887 he took 180 specimens of which 105 were stylopized. In 1888 they were much scarcer, although the climatic conditions were much the same, and the colonies undisturbed; of 60 specimens taken, 54 were badly attacked. In 1889 a few were taken, and in 1890 they had entirely gone. Although the evidence in this case is strongly in favor of the supposition that the stylops was the cause of the extinction of the colony, it must not be overlooked that perhaps Mr. Theobald and other zealous collectors also contributed greatly to the same end.

Only one other definite record of excessive parasitism is on record—that of *Polistes texanus* collected at Pecos, Texas, by A. E. Brown on September 25, 1901 (Skinner, 1903, *a*, *b*), in which 23 per cent of the wasps were parasitized. Only 17 per cent of the *Polistes annularis* studied by the author was parasitized.

The very recent study of *Andrena crawfordi*, however, has added another important instance under this heading. The extent of parasitism in this species has been cited in the conclusions just preceding and need not be further considered at this point.

It is of course undeniable that certain influences act upon each other in such a manner as to prevent the extermination of a species under ordinary circumstances. In order to explain this fact Marchal (1897 *a*) imagines a line or curve of numerical evolution for each species of insect. As the curve of the parasite increases it interferes with the corresponding curve of the host, causing a disturbance of the numerical equilibrium of the latter and consequently upsets the equilibrium of the parasite. Unless some external cause stops the downward curve of the two species by partially arresting the development of the parasite, the two species become extinct. In a state of nature this downward curve may be either checked or not, and hence the rising and falling curves will continue until there cease to be the proper external factors for retarding the downward curve. In other words Marchal wishes to show that the various organisms of nature are mutually dependent and that extraordinary circumstances will cause the extinction of numerous forms by removing some of the elements which naturally operate with or against each other.

2. *Loss of vitality by host.*

It is of course naturally to be expected, at least in cases where several parasites have attacked one individual, that the host should be greatly enfeebled. Hubbard (1892) in writing of *Polistes* (*amer-*

icanus) *crinitus*, says these wasps, which are active and belligerent, when overburdened with parasites "were lacking in vitality, and appeared to be on the sick list, as they rarely left the shelter of the nest." Brues (1903) states that the infested *Polistes annularis* are not as active as normal individuals but are often seen feeding at flowers. Mr. Dury on August 24, 1905, took a female *Polistes pallipes* so laden with parasites that it could hardly move. It contained 9 male pupæ.

Although these observations show a great loss of vitality, it must not be supposed that death occurs quickly in all cases. There are two periods in the biology of the parasites which are particularly grievous to the hosts. One is the period of hatching, when the triungulinids are crawling all over the body of the maternal host; and the other is the period of activity of the male, striving to release itself from its enshrouding envelopes. On a preceding page it has been shown that individuals of *Polistes annularis* lived between thirteen and sixteen days after the exit of males from their bodies and also were found hibernating thus. Brues (1905) found seven *P. annularis* in the field with empty puparia. Mr. Dury has kept *P. pallipes* as long as twenty-one days after, the emergence of the parasites. On July 19, 1906 Messrs. Bishopp and Jones took a *Polistes rubiginosus* with six empty puparia.

It is well known that bees usually travel great distances in search of the flowers they are accustomed to visit, the localities convenient for nesting seldom being in close proximity to the flowers. Hence it may be seen that the bees bearing parasites must often have considerable vitality remaining in order to visit the flowers, for in going to and from the flowers they must at one time or the other fly in the face of the wind. When heavily laden with a parasite this would be a rather difficult undertaking. It may be possible that parasitized bees do not return to the vicinity of the nests at night, but remain near the flowers. All parasitized bees taken in North America up to the present time and known to the author have been taken at flowers.

In the study of the parasitism of *Andrena crawfordi*, Mr. Crawford and the writer have made very close observations on all points possible. A diligent search for the nests of this species was made without avail. During April and May this bee is the most common species of the Andrenine bees and the flowers it frequents are the predominant flowers at Dallas, Tex. In past studies it has been found by them that dominant bees generally nest in communities or semi-communities—that is, that the nests are close enough together to be remarked. So far, in spite of very frequent excursions with this object in view no such conditions could be found. The effort was made to ascertain the direction of flight, but this led to nothing.

Two focal points were found around which the highest percentages of parasitism were noted; beyond this no more has yet been worked out.

The dominant flower is *Sitilias caroliniana;* it is everywhere. It opens about 7 a. m., and closes shortly after 9 a. m.; hence the collecting was all done between these hours. The flowers open in all kinds of weather and the bees visit them notwithstanding; on clear, sunny days they are very alert and fly easily, being disturbed by the slightest shadow, while on cloudy days they may be approached easily, and on damp, misty, or rainy days they rise with difficulty and fly slowly. It was always noticed that parasitized bees, especially those which had contained males, did not start easily, and were of a heavier flight, as though burdened and unbalanced.

3. Acceleration or retardation of development.

Whether the presence of the parasite actually influences the time of development of the host is as yet a matter of some conjecture. Saunders (1850), with regard to *Prosopis rubicola* bred in 1847, records "those bees which produced parasites being always observed in the imago state before others not parasitically affected," and in an unpublished notation opposite this remark Saunders has added: "Instance of this precocity exhibited also in the first reared in 1851. Exceptional, however."

The writer has observed, as recorded under the examinations of parasitized *Polistes annularis,* that the immature wasp larvæ which remained longest in the nest were unparasitized. These young were probably immune because no female parasite taken showed a sufficient development of eggs to have produced triungulinids in time to attack them.

In the case of *Andrena crawfordi* the evidence points decidedly toward acceleration. The first flowers of *Sitilias caroliniana* appeared about April 24; *Serinia oppositifolia* had been in flower a week longer. On April 26 the first *Andrena* were taken. On this and the two following days 74 bees were collected and 59 or 79 per cent were infested; 68 per cent of the parasites were males, and in only three cases were these still in the pupa state. After April 28 the per cent of parasitism rapidly decreased.

4. Alteration of general features.

Perez has contributed several very valuable articles on the effects of parasitism in *Andrena* and the author has established the groundwork of the following paragraphs on his work (Perez, 1886). A few observations by Mr. Crawford have been kept separate and inserted after section 5 (p. 34).

a. Abdomen.—In *Andrena trimmerana* the abdomen becomes sensibly shortened and inflated, and more or less globulose. The attenuation of the posterior segments becomes diminished and the terminal segments of the female become more pointed than normally. The teguments of the abdomen contract irregularly and often fold in drying after death, and assume a scarious appearance (Perez, 1886).

On July 3, 1906, at Dallas, Tex., Mr. W. A. Hooker collected a male *Leionotus annulatus* Say (fig. 1), at *Helenium tenuifolium*, containing one female *Leionotoxenos hookeri* Pierce. It seems that in pushing itself out between the segments the parasite completely split the dorsal tergites of segments three, four, and five, and split segment two halfway to the base. The parasite was located behind segment three. This is the first case known to the author of an actual injury to the body of the host.

The accident and subsequent recovery of the host is in itself remarkable, but the most curious part relates to the reparation of the wounded parts. The broken surface of segment two fused solidly to segment three and a portion of segment four, the line of fusion being shown by the difference in the puncturation. The right broken edge of segment three, continuing the fusion with segment two, fused solidly to the left broken edge of segment four, leaving a loose unconnected flap of segment three above. Thus the parasite's cephalothorax protrudes under the ledge formed by fusion of segments three and four and overlaps the right broken piece of the latter segment. Only a small piece of segment five is to be found. The right flap of the terminal segment is greatly developed in comparison to the left. As a consequence of the strange fusion the color pattern is greatly jumbled.

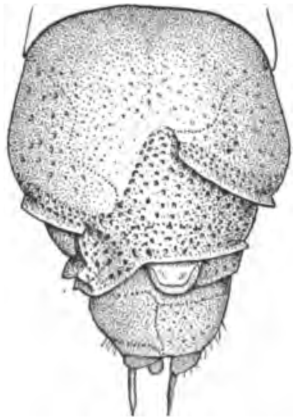

FIG. 1.—DISTORTED ABDOMEN OF LEIONOTUS ANNULATUS CONTAINING LEIONOTOXENOS HOOKERI.

With the inconsiderable amount of literature at hand, the writer can find only one reference to reparation of chitin. Packard (1898, 30) writes: "The reparative nature of chitin is seen in the fact that Verhoeff finds that a wound on an adult *Carabus*, and presumably on other insects, is speedily closed, not merely by a clot of blood but by a new growth of chitin."

This case is remarkable in that the insect recovered from wounds inflicted from within by the struggles of a parasite very nearly filling its abdomen, and inflicted at the time of metamorphosis while the body was still tender. There is no evidence whatever of parasitism causing a loss of vitality in this specimen. It is an interesting case in that it ably illustrates the power of chitin to fuse and protect the body in case of accident.

b. Head.—In *Andrena trimmerana* the head of the stylopized individuals is usually smaller than that of normal individuals. This condition is due to the turning of the nutritive elements to the abdomen where they are needed by the parasite (Perez, 1886).

c. Color.—Dr. W. M. Wheeler has found that parasitized *Polistes metricus* are much altered in coloration and has in preparation a series of notes on these color changes. *Prosopis gibba* occasionally exhibits irregular rufous patches on the abdomens of affected individuals (Saunders, 1850). *Prosopis rubicola* exhibits color change regularly. "The nymphs of those Hylaei which are likely to produce the pale-colored specimens (*H. versicolor*), which prove, as anticipated, to be only a variety of the *H. rubicola* consequent upon parasitic absorption, may usually be identified within one or two days of their final metamorphosis by assuming a yellow tinge, and may be set apart as certain to produce male parasites" (Saunders, 1852).

d. Villosity.—According to Perez the villosity of the abdomen of a stylopized *Andrena* is much more dense, especially on the last segments and its coloration is altered. In general the stylopized bee has the hairs of the last segments, more abundant, longer, more silky, both on the marginal fringes and the disk of the segments, and the color becomes lighter reddish or golden. As examples Perez (1886) cites *Andrena piceicornis* (stylopized) *isolita* Dufour, and *A. labialis* (stylopized) *separata* Smith. Note Mr. Crawford's observations on *Andrena crawfordi* beyond (p. 34).

The villosity of the thorax in species having scaly, short, appressed hairs covering the tegument may be altered by the elongation and redressing of the scaly hairs and giving them more of the appearance of ordinary hairs. As example Perez cites *Andrena aeneiventris* Moraw.

e. Punctuation.—The punctuation becomes finer, more superficial and closer, as for instance *Andrena trimmerana* Kirby, *Andrena fulvescens* Smith. Note the contrary observation by Mr. Crawford on *Andrena crawfordi* (p. 34).

5. *Alteration of external sexual characters.*

Secondary sexual characters.—*a. Color of clypeus.*—In the genus *Andrena* the color of the clypeus in many species is used to distinguish the two sexes, the males having a yellow or white clypeus while the females have the same black. It was found by Perez (1886) that when these species are parasitized the color of the clypeus tends toward the normal coloration in the opposite sex. To exemplify this point he cites the following species: *A.* (*variabilis*) *fimbriata* Brullé, *A. leucolippa* Perez, and *A. labialis* Kirby. Certain species were found to vary more readily on certain parts of the face than on other parts. Thus *A. decipiens* Schenck has the clypeus more frequently colored than the cheeks, and *A.* (*schencki*) *labiata* Schenck has the color more persistent on the cheeks than on the clypeus. Chitty (1902) found a specimen of *A. chrysosceles* Kirby, in which the clypeus lacked its usual conspicuous white color. In all females of *A. bipunctata* Cresson seen by the author there have been noticed the presence of yellow markings on the clypeus, which should not normally occur. One female had five yellow spots irregularly placed, while two others had a solid irregular blotch of yellow. One female of *A. cressoni* which normally has the clypeus black in that sex had yellow markings.

b. The fovea (*striga frontalis*), which in certain species is characteristic of the female only, is found to some extent in the stylopized male and suffers diminution in the stylopized female. Perez cites as examples *A. trimmerana* Kirby and *A. nigroaenea* Kirby.

c. The anal fimbria of the stylopized female sometimes entirely disappears, or the length and number of hairs is considerably reduced. On the other hand in the male the fifth and sixth segments of stylopized individuals sometimes become clad with long hairs so that the individual may be mistaken for a female. As exemplary of this change Perez cites *Andrena nigroeaenea* Kirby.

d. In the antennæ the relative lengths of the second and third joints of the funicle in the stylopized bee tend toward the characters of the opposite sex. This change is very clearly shown in *Andrena trimmerana* Kirby by Perez's figures (1886).

e. Organs of work tend to assume the form found in the other sex. The female tibia becomes slender, and less enlarged outwardly; the hairs diminish in development and number; the tibial brush disappears. The coxal and metathoracic scopa (*houppes*) suffer a diminution in number, size, and curve of hairs. The female metatarsal brushes become diminished by the lessening of the strength and number of hairs and the enlargement of the joint is diminished. The males on the contrary sometimes show an enlargement of this joint and a marked developement of the brush, as for instance *A. trimmerana* Kirby (Perez, 1886). Mr. Crawford also noticed in several stylopized *Andrena* in the writer's collection, a diminution in the size of the tibiæ, but as no normal specimens were procurable at the time more definite data can not be given at this writing. Note his statement concerning *Andrena crawfordi* (p. 34).

Primary sexual characters.—*a. Ovipositor.*—In stylopized females the ovipositor becomes shortened. Perez records a female *A. afzeliella convexiuscula* with this organ shortened one-third.

b. In stylopized male bees the copulatory apparatus becomes diminished in length, width, and curvature.

c. Stylopized leafhoppers can hardly be determined on account of alterations of the genitalia according to Prof. E. D. Ball.

That parasitism does not entirely prohibit copulation is evidenced by several records. Mr. Dury took a female *Leionotus foraminatus* Saussure, containing a female parasite in the third segment, while in copulation on August 10, 1901, at Cincinnati, Ohio.

Perkins (1891) showed that males containing female stylops were "apparently capable of reproduction." He also cites (1905) Piffard as collecting a stylopized male bee copulating, but probably the most conclusive record of all is that of a male *Tetigonia*, "bearing two great male puparia and two mature female parasites, which was in copula with a female carrying three or four parasites."

On April 27, 1906, Mr. Crawford took a male and female *Andrena crawfordi* in copula, each of which bore an empty male puparium. On April 28 he took a pair in which the male was unparasitized and the female bore two female parasites. On April 30 the author took a pair in which the male bore a female parasite and the female was unparasitized.

Owing to Mr. Crawford's knowledge of the available characters in Apoidea, the writer has submitted all of his parasitized material to him for examination. The results of Mr. Crawford's observations upon *Andrena crawfordi* are given below, and the writer feels it incumbent upon him to acknowledge the services of Mr. Crawford in this respect and upon this point.

1. Puncturation of abdomen less strong, punctures finer and sparser; especially noted on second segment.
2. In females with male parasites the basal joint of the hind tarsi is narrower, approaching the shape of the corresponding joint of the male tarsi; this joint not noticeably narrowed in female with female parasites.
3. Scopa of parasitized female thinner, plumosity shorter, not so silky.
4. Out of 6 males with male parasites 2 show the second transverse cubital gone in both wings; 1 has stubs at each end, however, in right wing; 1 has the first transverse cubital slightly interrupted in both wings. Out of about 110 nonparasitized males none show any variation.
5. Out of 38 females with male parasites 1 has the left wing with 3 submarginals, the right wing with 2 submarginals; 1 has 2 submarginals in both wings but right wing with a stub of the nervure; 1 has first transverse cubital of the left wing one-half gone; 45 nonparasitized females show no variation.

None of the other salient alterations found by Perez could be expected in this species because of the close resemblance of the two sexes. *Andrena crawfordi* is a very generalized bee.

The left wing of the only parasitized specimen of *Andrena advarians* in the writer's collection has a spurious nervure in the third discoidal cell. Whether due to parasitism or not, such an aberration is of interest. The results of wing examination in *Andrena crawfordi* would lend credence to the assumption that parasitism does affect the tracheation of the wings. A larger series is necessary to prove this point.

Mr. Crawford has furnished the following list of *Andrena* which are known to lack the second transverse cubital vein at times. It would be interesting to know whether parasitism was invariably the cause.

Andrena arabis Robertson.
  crawfordi Viereck.—A known stylopized species.
  geranii Robertson.
  illinoiensis Robertson.—A known stylopized species.
  platyparia Robertson.
Opandrena bipunctata Cresson.—A known stylopized species.
  personata Robertson.
  robertsonii Dalla Torre.—A known stylopized species.
Pterandrena asteris Robertson.
  krigiana Robertson.
  solidaginis Robertson.—A known stylopized species.
Trachandrena claytoniæ Robertson.—A known stylopized species.
  forbesii Robertson.
  hippotes Robertson.—A known stylopized species.

6. *Synonymy due to stylopization.*

Stylopization may so change a species that it can not be identified unless one understands the direction of the changes under such conditions. A stylopized male or female is a male recovering the characters of the female, or a female borrowing the attributes of the male (Perez, 1886).

Notable examples of forms based on stylopized individuals are:

Andrena afzeliella (stylopized) *convexiuscula* Kirby.
Andrena nigroænea (stylopized) *aprilina* Smith.
Andrena, sp.? (stylopized) *picicrus* Schenck.
Andrena solidula (stylopized) *junonia* Viereck.
Andrena subtilis (stylopized) *angustitarsata* Viereck.
Andrena tibialis (stylopized) *mouffetella* Kirby.
Andrena trimmerana (stylopized) *picicornis* Kirby.
Andrena trimmerana (stylopized) *picipes* Kirby.
Prosopis rubicola (stylopized) *versicolor* Saunders.

It is very probable that most of the complicated synonomy in *Andrena* in Europe is due to stylopization.

Two of the above instances are on the initiative of the writer with the support of Mr. Viereck, the describer. The latter stated (Viereck, 1904, 222) concerning his *Andrena junonia*—

> This may be *solidula* altered by *Stylops*.

The species were separated thus:

> ♀ Face with ochreous hairs; first recurrent nervure received beyond the middle of the second submarginal cell; pleura with pale pubescence—*solidula*.
>
> Face with ochreous hairs; first recurrent nervure received before the middle of the second submarginal cell; pleura with pale pubescence—*junonia*.

Both *junonia* and *solidula* are parasitized by *Stylops solidulæ*.

Andrena angustitarsata was described thus:

> ♀ 9 mm. Pubescence ochreous; fovea ochreous. This is a stylopized specimen and may be an aborted *A. subtilis*, the abortion due to the presence of the stylops.

The species is separated from *subtilis* as follows:

> ♀ Metatarsus of posterior legs one-half as wide as the tibiæ at apex; inclosure smooth; abdomen indistinctly fasciate—*angustitarsata*.
>
> Metatarsus of posterior legs more than one-half as wide as the tibiæ at apex; inclosure smooth; abdomen fasciate; clypeus indistinctly punctured, dull, pubescence sparse—*subtilis* (Viereck, 1904-1906).

Several interesting points in nomenclature have been worked out, among which probably the most interesting is as follows:

Andrena convexiuscula and *Andrena afzeliella* were both described by Kirby on the same page, the former being placed first. Smith (1855, 103) found that *convexiuscula* was a form entirely due to parasitism and only existed as parasitized individuals, which according to Perez (1886) are usually unable to reproduce. Perez found that *afzeliella* is the normal, unparasitized form of the same species, although certain unmodified individuals were found parasitized. He therefore wrote the species *Andrena afzeliella convexiuscula* Kirby (Perez, 1886). Dalla Torre (1896), following a strict interpretation of the rules of priority, wrote the species *Andrena convexiuscula* (stylop.) *afzeliella* Kirby in which he incorrectly stated the case. Alfken on the other hand in 1899 reversed the matter and restored Perez's manner of naming it. In order to be certain on this matter the writer placed the question before Dr. C. W. Stiles, who decided that the first decision, that of Perez, should stand.

In the list of hosts in the genus *Andrena* several forms of nomenclature will be noted:

1. "*Andrena bicolor* Fabr. form *gwynana* K. (æstival)," indicating that the two generations of this species are dissimilar and have received different names.
2. "*Andrena afzeliella* K.," indicating a typical species.
3. "*Andrena afzeliella* K. (stylop.) *convexiuscula* K.," indicating a form due entirely to stylopization.

4. "*Andrena afzeliella fuscata* K.," indicating a normal variation.

5. "*Andrena tibialis* K. (*atriceps* K.)," indicating a synonym which has been used in the literature on the subject.

7. *Injury to internal organs.*

a. Alimentary system.—Newport (1851) found in *Andrena trimmerana* Kirby the intestine of a parasitized bee to be almost entirely empty and thrust out of its usual position.

b. Nervous system.—The same entomologist found the ganglia of the abdominal portion of the nervous cord to have been atrophied and smaller than usual.

c. Respiratory system.—Newport likewise found the organs of respiration to be small and imperfectly developed, and retaining more the tracheal condition of the bee larva than that of the adult insect, the vesicles being few and imperfect.

d. Secretion.—Newport found the secretory tubes and poison glands reduced. Saunders (1850) writes as follows of *Prosopis rubicola* Saunders:

> Having noticed two pupæ exhibiting on the right side only, the dark markings which usually precede the development of the bee, I found, on their pupa-pellicles being discarded the next day, that strepsipterous parasites ready to burst forth, had become conspicuously prominent on the opposite side, where their hitherto concealed presence would seem to have had the effect of exhausting the ordinary secretions within.

e. Reproduction.—As a result of stylopization an arrest to the development occurs, effecting an atrophy of the ovary. In stylopized females the largest eggs are smaller than their vitellogenous cells, but the contents of the cells are unchanged. A parasitized female with pollen on its brush showed the external signs of parasitism and likewise had the eggs very far from development. Perez found such conditions in *Andrena flessæ* Panzer, *A. labialis* Kirby, *A. decipiens* Smith, *A. ranunculi* Perez.

8. *Effects upon normal functions.*

Perez has pointed out that before a female becomes conscious of its functional duties, incident to the development of eggs, it will not perform any of its usual functions, and that in cases where the development of the ovary is arrested there is seldom any attempt to carry pollen, or build, or furnish nests. The case of the bee just cited may possibly be an exception, but the writer finds that a great many of the females of *Andrena crawfordi* which are parasitized have considerable pollen on their legs.

9. *Effects subsequent to exit of male.*

The exit of the male does not necessarily premise death to the host, as has been shown in a previous paragraph. There are, however, external conditions which take advantage of the cavity left by the male and cause death. Brues (1903) believes that a drying of the viscera is incident to the escape of the male because of the admission of air through the often broken pupal envelope. Perkins (1905) asserts that the leafhoppers generally die within a few hours or days after the exit of the male parasite and attributes this to drying and the access of light. He holds that insects parasitized by males are weaker than those containing females, so they are probably even more susceptible on this account.

An after effect recorded only by Perkins is that of fungus attack, regarding which he says:

> Again in the case of leaf-hoppers, at least at certain seasons, no sooner does the male parasite emerge than a fungous disease at once starts its attack in the opening thus made, the results of which are absolutely deadly. Sometimes, but much more rarely, one will find the fungus has developed at the point of protrusion of the female parasites. This fungus disease seems to be a constant concomitant of stylopid attack on leaf-hoppers, both in America, Australia, and Fiji.

The records under *Polistes annularis* indicate a strong possibility that some wasps from which a male parasite has escaped can successfully pass through hibernation.

3. EFFECTS OF VARIOUS HOST CONDITIONS UPON THE PARASITES.

This section is somewhat difficult of treatment, as but few instances can be found upon which to base the discussion.

1. The parasites are dependent upon light in effecting their freedom. Saunders (1850) writes:

> So long as the Hylæi remained in the dark the parasites, deprived of those external influences which under ordinary circumstances would serve to stimulate their dormant energies, made no attempt to abandon their pupa tenements; as an incentive to which light appears to be absolutely essential in order that their perceptions may be awakened to an intuitive consciousness of the bees having quitted their cells.

2. The death of the host does not occasion the death of a male parasite in the pupa stage. Saunders (1852) found an *Hylechthrus* alive five days after the death of the bee. Regarding this record a manuscript note by him in the author's personal copy reads:

> Produced in 1851 from a dead *Hylæus* on placing merely in the window, under the influence of a strong light, but without additional warmth from the sun.

Mr. Dury hatched a male *Ophthalmochlus duryi* from *Priononyx atrata* on August 19, at Cincinnati, Ohio, three days after the death of the host.

3. The enmity of ferocious hosts may result in the death of some males, as is evidenced by Hubbard's records of *Polistes* (*americanus*) *crinitus*.

4. An accidental event was noted by Mr. Dury of a male breaking its pupa-case and emerging into the body cavity of the host, where it died.

5. Fungus attack, in the case of Homoptera, following the exit of a male parasite means death to the remaining parasites.

6. Perez noted a case of the exclusion of a parasite, which had forced its cephalothorax through the pellicle of the pupa at the time of transformation.

7. The sex of the host in a measure determines the mortality of the parasites. In the case of *Polistes* at least the males do not hibernate, while a fair per cent of the females do. By a glance at the paragraphs on extent of parasitism it will be noted that in the autumn the greatest per cent of the parasites were found in the male hosts and that not more than 1 per cent of the female parasites could be expected to exist through the winter, as only such hosts as contained females alone can as a rule stand the rigor of the winter season. (*See Polistes annularis* on pp. 17–20.)

4. BIOLOGY OF THE HOST AS INFLUENCING THE BIOLOGY OF THE PARASITE.

1. Biology of the host.

a. In order to invite attack the host must be in the larval state as demonstrated by Saunders (1852) with *Polistes* larvæ.

b. The development of host and parasite is generally parallel, the exsertion of the puparium of the parasite occurring very shortly after maturity, and being followed in a few days by the exit of the adult. This point will be discussed more fully under the biology of the male parasite. In Homoptera, however, the reverse may often occur. Perkins (1905) writes:

> In the case of the Halictophaginæ we found only mature leaf-hoppers to contain mature female parasites and puparia, but in the case of *Elenchus tenuicornis* the nymph or adult delphacids will alike produce mature parasites of either sex.

2. Social economy of hosts.

The economy of the parasites is directly related to the economy of the hosts. It is somewhat remarkable that among the latter are found very nearly all of the important conditions of social economy known among insects. As the general subject falls under several distinct heads, the exact bearing on the present problem may be better shown by so dividing the discussion.

a. Interrelationship of hosts.—Gregarious insects.—Very little is known of the parasitism in the Gryllotalpidæ and Scutellaridæ, but our knowledge of the elenchid and halictophagid parasites of the Homoptera is constantly on the increase, thanks to the zeal of Mr. Koebele and Mr. Perkins. The Homoptera may very truly be said to be gregarious, for, to quote Osborn and Ball (1897), there are "numerous species of Jassidæ which swarm, often by millions to the acre, upon various species of grass." Under such conditions the minute triungulinids swarming over the grass should have little difficulty in reaching a host, and males should have but a slight distance to travel in order to find a female.

Solitary insects.—Under this grouping fall all of the Sphecoidea, the Eumenidæ, and all of the Apoidea except *Halictus*, which are listed as hosts. The Sphecoidea include ground dwellers and mud daubers, among which the bembecids often dwell in large communities. The writer has observed only two such communities at Lincoln, Nebraska; but Hartman (1905) writes:

> *Microbembex* and *Bembex* are both common in the sandy woods, where they often form large mixed colonies, building their nests side by side in great numbers. When a novice first comes upon one of these populous colonies on mid-day, when business is at its height, he is bewildered by the great number of wasps engaged in the general hubbub around the many holes that riddle the ground.

The Sphecidæ are not communal, being somewhat averse to sociability. Hartman (1905) recalls a fierce combat of two *Ammophila* which happened to dig their nests near each other. The nests of *Sphex* (*Ammophila*), *Chlorion* (*Sphex*) and *Priononyx* are dug in the ground, the parents being very particular as to the location. But one egg is laid in a hole. *Sceliphron* (*Pelopæus*) is a mud dauber and builds several cells adjacent to each other.

The Eumedidæ are solitary workers, constructing a series of loose cells at the base of grass clumps, constructing tubes in holes in wood, in stems of plants, or cementing neat little pots on twigs.

Among the Apoidea a great diversity of nesting habit occurs. As far as the writer knows, *Panurginus*, though dwelling in the ground, (Pierce, 1904) is not communal in habit. *Halictoides*, *Andrena*, and *Halictus* are ground dwellers. Mr. Crawford has found large numbers of *Andrena pulchella* and *Halictoides marginatus* dwelling in one community at Lincoln, Nebraska. *Halictus* is also found often in communities. *Prosopis* nests in galls and constructs galleries in briars.

Among these solitary insects may be noted two conditions—those that are strictly solitary and those that are semisocial, and live in communities. It may be surmised without much doubt that under the latter condition it is easier for male parasites to find females, since the hosts are generally in swarms. Likewise triungulinids from feeble hosts can more readily reach new hosts in a community than where the hosts are widely separated. *Halictus* is really semisocial, as several females use the same hole.

Social insects.—The remainder of the vespoid hosts fall under this category. They build large nests and observe a division of labor. Triungulinids may with ease pass from their maternal host to the cell of a new larva. Fertilization of the parasites probably takes place among the swarm at the nest.

Here also fall the formicid hosts, which practice division of labor in subterranean nests. Since little is known of the parasitism of ants, the discussion can go no farther.

b. Food habits of adult hosts.—*Spermophagous insects.*—Among the seed-eating insects may be noted only the ants. As the transfer of the triungulinids probably occurs on the ground or in the nests no significance is noticed in the food habit.

Predaceous insects.—The ants belong also under the head of predaceous insects. Here also may be classed all of the Sphecoidea and the Eumenidæ. These wasps are all philotropic and will be more fully discussed under that heading.

Herbivorous insects.—This group includes the Gryllotalpidæ, Scutellaridæ, and Homoptera. Apropos of the Homoptera, Osborn and Ball (1897) write:

> The species of Jassidæ have, as a rule, a decided limitation as to food plant, usually holding closely to one species of plant, almost invariably limited to one plant for breeding, but feeding more indiscriminately in mature stages.

This statement may be applied to most, if not all, of the homopterous hosts thus far recorded. It may be readily seen that where an insect is confined to certain definite food plants the transfer of triungulinids can be much more easily accomplished than where the hosts are indiscriminate feeders.

Philotropic insects.—The majority of the hosts known are flower frequenters, and as such are classed as oligotropic when visiting a single species, genus, or family of flowers, and polytropic when visiting many genera or families of flowers. It is very reasonable to infer that the most ordinary method of transfer of triungulinids takes place at flowers, because of the analogous forms of strepsipterous and rhipiphorid triungulinids. Most of the wasps are flower visitors, because they may quench their thirst in the nectarine liquids. They are consequently polytropic; but the bees are more highly developed and often specially adapted for particular flowers, hence many of them are oligotropic. In this connection the following table may be introduced, giving the range, season, and flower records of the most important hosts of *Stylops* in North America. The list is compiled from the writings of Charles Robertson, Sigmund Graenicher, T. D. A. Cockerell, and Henry L. Viereck, and from records of J. C. Crawford, and host records in possession of the writer, referred to at numerous places in the text. The species are arranged according to season.

Genus *Andrena* sg. *Andrena*.	Genus *Stylops*.	Range.	Season.	Flowers.
hartfordensis Cockerell.	*hartfordensis* Pierce.	Wisconsin, Connecticut, Georgia.	Mar. 27 to June 2.	*Angelica*, *Symphoricarpos*, *Taraxacum*, *Thaspium*, *Vagnera*, *Viburnum*.
illinoiensis Robertson.	*bruneri* Pierce	Washington, Nebraska, Wisconsin, Illinois.	Apr. 2 to May 7.	*Amelanchier*, *Erigenia*, *Geranium*, *Salix*, *Stellaria*.
vicina Smith	*vicinæ* Pierce	British Columbia, Washington, Oregon, New Mexico, Wisconsin, Massachusetts, Connecticut, New Hampshire, Canada.	Apr. 15 to June 18.	*Caltha*, *Erythronium*, *Prunus*, *Ribes*, *Rosa*, *Salix*, *Sanguinaria*.
polemonii Robertson.	*polemonii* Pierce	Colorado, Illinois	Apr. 20 to Apr. 28.	*Polemonium*.
nivalis Smith	*graenicheri* Pierce	Wisconsin, Hudson Bay.	May 9 to June 27.	*Cornus*, *Geranium*, *Heracleum*, *Ribes*, *Rubus*, *Thaspium*, *Vagnera*.
corni Robertson	*cornii* Pierce	Illinois, Wisconsin.	May 27 to July 9.	*Angelica*, *Cornus*, *Rhus*, *Rubus*, *Rosa*, *Sanicula*, *Viburnum*.
multiplicata Cockerell.	*multiplicatæ* Pierce.	Wisconsin	May 29 to July 30.	*Ceanothus*, *Cornus*, *Rhus*, *Spiraea*, *Symphoricarpos*, *Thaspium*, *Veronica*.
nubecula Smith	*nubeculæ* Pierce	Colorado, Nebraska, Illinois, New York, New Hampshire, Nova Scotia.	July 26 to Oct. 9.	*Aster*, *Solidago*.
sg. *Pterandrena solidaginis* Robertson.	*swenki* Pierce	Nebraska, Illinois, Wisconsin, Pennsylvania.	Aug. 22 to Oct. 11.	*Aster*, *Boltonia*, *Poligonum*, *Solidago*.
crawfordi Viereck.	*crawfordi* Pierce	Texas	Apr. 26 to May 23.	*Sitilias*, *Serinea*, *Lindheimera*, *Engelmannia*.
sg. *Opandrena bipunctata* Cresson.	*bipunctatæ* Pierce	Nebraska, Texas, Wisconsin, Illinois, Indiana, New York, Alabama.	Apr. 5 to June 17.	*Amelanchier*, *Angelica*, *Claytonia*, *Cornus*, *Cratægus*, *Erigenia*, *Prunus*, *Salix*, *Staphylea*, *Stellaria*, *Symphoricarpos*, *Viburnum*, *Zanthoxylum*.
cressonii Robertson.	*cressoni* Pierce	Vancouver, British Columbia, Oregon, Wisconsin, Illinois, Maine.	Apr. 5 to July 5.	*Acer*, *Amelanchier*, *Claytonia*, *Cornus*, *Geranium*, *Heracleum*, *Hydrophyllum*, *Pastinaca*, *Pimpinella*, *Polytænia*, *Prunus*, *Salix*, *Sanicula*, *Stellaria*, *Vagnera*, *Zanthoxylum*, *Zizia*.
robertsonii Dalle Torre.	*robertsoni* Pierce	Illinois, Wisconsin, Ohio.	June 26 to July 16.	*Ceanothus*, *Krigia*, *Rhus*.
sg. *Ptilandrena erigeniæ* Robertson.		Illinois, Wisconsin.	Mar. 26 to May 14.	*Claytonia*, *Erigenia*, *Hydrophyllum*.
sg. *Trachandrena claytoniæ* Robertson.	*claytoniæ* Pierce	Illinois, Wisconsin, Georgia.	Mar. 21 to June 4.	*Amelanchier*, *Antennaria*, *Cercis*, *Claytonia*, *Heracleum*, *Salix*, *Zizia*.

Genus *Andrena* sg. *Andrena.*	Genus *Stylops.*	Range.	Season.	Flowers.
saliciflaris Cockerell.	*saliciflaris* Pierce..	Vancouver, British Columbia, Washington.	Apr. 4 to June 3.	*Ribes, Salix.*
hippotes Robertson.	*hippotes* Pierce....	Washington, Oregon, Wisconsin, Illinois, Ohio.	Apr. 21 to June 26.	*Angelica, Celastrus, Salix, Spiræa, Prunus, Viburnum.*

Since *Andrena crawfordi* is a new species, and the material belonging to Mr. Crawford and the author is typical, it may be of interest to introduce the records taken to date. *Sitilias caroliniana* is the typical flower. During 1905 none were collected on anything else. During 1906 104 male bees and 100 female bees were taken at this flower; 9 male bees and 9 female bees were taken at *Serinea oppositifolia;* 34 male bees and 5 parasitized female bees were taken at *Lindheimera texana,* 3 male bees at *Engelmannia pinnatfida,* and 1 male at a species of *Aplopappus.*

A few characteristics have been provisionally set down for the divisions of the old genus *Andrena,* some of which may be of interest. *Ptilandrena* is supposed to be generally oligotropic and vernal; *Opandrena* and *Trachandrena* are vernal; *Andrena* is vernal with the exception of *A. nubecula; Pterandrena* is autumnal with a few exceptions. *Pterandrena* and *Opandrena* are characterized by yellow face markings in the males, and hence here are to be found those species which will show color variation on the clypeus of parasitized individuals. By vernal is meant that the bees finish their flight before July 30.

c. Food habits of immature hosts.—The manner of feeding the young or of starting them into life has a very direct bearing on the economy of the parasites. For purposes of convenience this subject is divided into three groups.

Autophagous larvæ.—Those larvæ which are entirely self-feeding and not dependent upon the parent for more than the deposition of the egg in a proper place may be known as autophagous (from *αὐτός* = self + *φαγεῖν* = to feed). The homopterous, heteropterous, and orthopterous hosts are all autophagous, and furthermore are open-air feeders, thus enabling the triungulinids to attack them at any time during their larval period.

Chilophagous larvæ.—Those young which feed upon stored up or foraged provisions are here designated as chilophagous (from *χιλός* = forage + *φαγεῖν* = to feed). Under this group may be placed the Sphecoidea with the exception of some Bembecidæ, and the Apoidea. All hosts which store food for their young, that is trophapothetic insects (from *τροφή* = food + *ἀπόθεσις* = storing), which seal the nests up as soon as sufficient food is stored for the nourishment of the larva, belong under this grouping. It is needless to say that in such cases there is but the brief period of about a day during which the triungulinids may reach their prospective hosts, and that they must in some cases wait several days for the host larva to leave the egg stage. When the hosts are predaceous the chances are that they seldom visit flowers during the nest building period, and it may be necessary for a triungulinid to remain for days on a flower or on a secondary host while it awaits an adventitious moment for furthering its search of a permanent host.

When the hosts are pollen-gatherers it is probable that multitudes of triangulinids may be swarming over the nest builders awaiting an opportunity to settle in newly made nests.

Heterophagous larvæ.—Those young which require to be fed by others have been called heterophagous (from ἕτερος = another + φαγεῖν = to feed). Under this grouping belong the Formicoidea, Vespoidea and *Bembex* and *Monedula* in the Bembecidæ. Concerning these latter genera, Hartman (1905, 25) writes that "*Microbembex,* contenting herself with any insect she finds, has an advantage over *Bembex,* her nearest relative, and *Monedula,* both of which feed their larvæ from day to day." Peckham and Peckham in "The Solitary Wasps," page 67, corroborate this statement, but Hartman shows (1905) that *Bembex belfragei* after storing the hole closes it up.

As these larvæ are accessible to triungulinids throughout this period of their existence it is reasonable to expect that parasitism among them should reach a very high percentage.

d. Life cycle of hosts.—*Homoptera.*—Concerning the leaf hoppers, Osborn and Ball (1897, 613) state that:

> There is a wide difference in life histories, some having one brood, the majority of the grassfeeding species two, and still others three in a season, and the successive stages occurring at widely different times.
>
> Except in the case of adult hibernation the ordinary life of a brood of adults does not exceed two months, and for the individuals of a brood rarely over one. The males appear a week or ten days before the females and disappear as much earlier. In general one brood of adults will have disappeared before the larvæ of the next have matured, so that individuals collected at any time may be referred with assurance to a particular brood.

This summary is very useful, as it indicates in a few words the exigencies of parasitic life among the Elenchidæ and Halictophagidæ. There must be one to several broods of parasites, according to the number in the host species. It is probable that adult fertilized females hibernate in adult hosts. The period between broods must be bridged by the triungulinids in waiting unless an alternation of hosts takes place. Systematic studies do not at present support the theory of alternation of hosts. The epoch of parturition must be rapid.

The other prominent conditions of host biology may be best glanced over by quoting four paragraphs from Saunders (1850), in which he discusses the bearing on the parasites.

Polistes.—

> It is well known that among wasps neuters alone are produced up to a certain period, upon which the duty subsequently devolves of preparing the cells set apart for females; and the *Xenos* being essentially dependent upon the hibernation of the latter the female parasite of the preceding year must either await the occasion when the cells of the female wasps are so prepared for the reception of ova, or otherwise, transmitting her posterity to these females through the intermedium of neuters in the first instance, the *Xenos* would thus prove to be double-brooded.

The statistics previously quoted concerning parasitism of *Polistes annularis* would amply bear out this conclusion, or rather that there is almost continuous breeding of the parasites throughout the summer.

> Under the peculiar embryogenous and metamorphotic conditions affecting the continuations of the species it is manifest that these parasites could not perpetuate their existence in company with the social Vespidæ unless the epoch of parturition were thus protracted until the following year, so as to enable them to transfer their hexapod progeny to the succeeding colony of wasps.

This conclusion is proven by the breeding of male parasites from *Polistes annularis* in October and the fact that all of the fall female parasites were but just mature and that the eggs had just begun to form. Male parasites are probably rarely carried through the winter on account of the unusual debilitating influences felt by the hosts bearing them.

Andrena.—

> In the case of *Stylops*, * * * the necessity exists for the rapid development of the ova, the Andrenæ enjoying but a limited term of existence at large, and it being therefore essential that within the brief period of a few weeks the female parasite should fulfill the part assigned her and the young hexapods be ready to occupy their appointed stations in the larva cells of the bee, soon about to be closed.

In the case of *Andrena* hibernation is probably mainly in the immature stage in both host and parasite.

Prosopis.—

> A corresponding urgency is imposed upon these parasites on *Hylæus*, although the larva state of the latter continuing throughout the winter and spring involves the necessity of a suitable conformity of habit in the parasite.

BIOLOGY OF THE PARASITE.

FERTILIZATION.

The differentiation of sexes in this order renders the subject of biology one of great interest. The helpless female must lie motionless in the body of its host with only the cephalothorax protruding and await the coming of the active, nervous male.

That the female must be fertilized can hardly be doubted, and yet the nature of the act and the fact itself has been but slightly proven.

Saunders (1850) states that the presence of eggs has never "been detected in any vermiform strepsipterous insect obtained from a bee or wasp not taken at large." In 1852 Saunders records having placed a *Prosopis rubicola* Saunders bearing a female which had just transformed with a male *Hylechthrus rubi* Saunders on June 25, and that the male took no notice of the female. On the 26th the experiment was tried with other males without result. On the 27th it was placed with a male which had just quitted its pupa case, the latter immediately settling "upon the abdomen of the bee, quivering his expanded wings, while recurving the abdomen considerably in the direction of his secluded partner, and returning on several occasions to repeat the process." Sagemehl (1882) took a male stylops in copulation on *Andrena parvula* Kirby.

When Mr. Crawford collected the unique male of *Crawfordia pulvinipes* Pierce he did so by accident. He had just bottled a *Panurginus* which was new to him, and on looking at it in the tube he noticed a commotion on the abdomen. The male parasite was attached to the female in the bee's body. It was in an erect position, with the head pointing forward. This would indicate that the abdomen was doubled forward. Fertilization was probably effected by the release of the semina in the brood chamber or in the alimentary canal.

The most recent work on the subject has added an interesting observation on this point. Muir, in speaking of the activity of males of *Elenchoides perkinsi* Pierce (*Elenchus tenuicornis* Muir not Kirby), writes:

> If the hopper bears a mature female parasite, the male settles about half an inch away and crawls toward the hopper, vibrating its wings all the time. This generally disturbs the hopper and it moves off, the *Elenchus* following till it gets a chance to spring upon its back and attach itself to the female. This action disturbs the hopper and it flicks its abdomen to shake off the parasite. * * * I have never seen the male *Elenchus* retain its hold of the female for more than six seconds; generally it is attached only two or three seconds. I am unable to say if fecundation takes place during this time, or exactly how copulation takes place; evidently the tip of the abdomen is inserted into the brood chamber.

OOGENESIS.

This subject has been handled very ably and to considerable length by Brues (1903), and it is therefore only necessary to quote his summary:

> Oogenesis is peculiar and does not resemble that of other insects. Very small larvæ show strings of spherical primitive eggs on each side of the gut. These grow and later break up, giving rise to eggs, each of which consists of a mass of nurse cells bearing a polar cap of cells derived from a primitive egg attached to it. Yolk is formed from the contents of each egg, and when ripe the eggs are scattered about all through the body cavity and lie embedded in the fat body. Maturation seems to occur through the fusion of the second polar body with the pronucleus of the egg. All of the cleavage cells when formed go to make up the blastoderm, which does not cover the whole

egg at first and later draws up to one pole to give rise to the rudiment of the germ-band by a rearrangement and multiplication of its cells. Older embryos are of the usual generalized type, although on account of their length they are curled up in the egg in a peculiar manner.

The foregoing is the oogenesis of *Acroschismus wheeleri* Pierce (*peckii* Brues). Whether this process is the same throughout the order will probably remain for some time a matter for conjecture.

LARVIPAROUS REPRODUCTION.

There is no possibility of oviposition in this order. The period of parturition is passed in the body of the parent, and the young hexapods reach the open air by passing from the body cavity of the parent into a canal formed between the parent's skin and its uncast pupal skin, and thence through a slit opening on the ventral or uppermost side of the cephalothorax, between the head and thorax. The young swarm over the parent's body in immense numbers. Newport (1851) computes that more than 7,000 triungulinids were produced by one female *Stylops aterrima* Newport in *Andrena trimmerana* Kirby. The writer (1904) counted 2,252 young of *Stylops swenki* Pierce (*Xenos?* species) from *Andrena solidaginis* Robertson, omitting all consideration of multitudes of undeveloped eggs. These young reach a new host in one way or another, already described, and immediately commence the attack. Saunders (1852) found that *Xenos* larvæ became completely buried in the body of *Polistes* in three hours, and the next day were completely out of sight.

METAMORPHOSIS.

The discussion of this subject must be confined almost exclusively to *Xenos vesparum*. After the triungulinid has entered its host it commences a development which involves some of the most interesting phenomena known among insects. The campodeoid hexapod grows so rapidly that it soon loses all semblance to its former self and the body grows out of all proportions to the legs. From this point in the biology of these larvæ Nassonow (1892 *e*) must receive all of the credit, and reference to his plates will be of much value. The second instar is devoid of legs and scarabæidoid in form. In the first part of this instar the head, three segments of the thorax, and ten segments of the abdomen are distinct and ventrally flattened, the abdominal segments being shorter than the thoracic (Nassonow, 1892 *e*, pl. 1, fig. 5). During the latter portion of the instar the body becomes cylindrical, and the abdominal segments become as long as the thoracic (Nassonow, 1892 *e*, pl. 1, fig. 6). From this point the development of the male and female is radically different, and it will be best therefore to compare them in parallel columns.

Male.	*Female.*
The third instar shows a partial fusion of the first two thoracic segments with the head still separate. Last abdominal segment fused with the preceding, the segment appearing longer and posteriorly narrowed (fig. 13).	The third instar shows a partial fusion of the first two thoracic segments, with the head still separate. Last abdominal segment fused with the preceding, the segment thus appearing obtuse (fig. 7).
In the fourth instar the anterior end of the head is more pointed, and the eye-spots are smaller; the segments of the thorax are fused; and the rudiments of the legs become more distinct (fig. 14).	In the fourth instar the anterior end of the head is more pointed, the head is shorter, with the eye-spots at the posterior edge; the thorax is differentiated from the abdomen and the segments are fused (fig. 8).
In the fifth instar the head and thorax fuse into acone-like cephalothorax, with a distinct ring suture (fig. 15).	In the fifth instar the head fuses with the thorax forming the cephalothorax, but with the suture discernible (fig. 9).
In the sixth instar the cephalothorax is more differentiated from the abdomen. The anal pore on the tenth and the genital pore on the ninth segments are both distinct (figs. 16, 17).	In the sixth instar the eyes are not perceptible; the cephalothorax is markedly differentiated from the abdomen, flattened dorsally, and somewhat widened; the sutures between the segments completely disappear (fig. 10).
The seventh instar is passed within the skin of the sixth and is really a pupa. The appendages become strongly developed. During this stage the puparium is pushed outwards (figs. 18, 19).	In the seventh instar the cephalothorax is strongly flattened dorsally, depressed and chitinized. The cephalothorax is exserted at this time (figs. 11, 12).
The second or real pupa forms within the skin of the seventh instar. It is essentially similar to the Hymenopterous pupæ (fig. 22).	
The adult male breaks forth from the two pupal skins and thrusts off the cap, or operculum, of the puparium, which was the head of the sixth instar.	The adult female is closely inclosed by the integument of the preceding instar.

ALIMENTATION.

In various places mention has been made that alimentation is probably by osmosis. All evidence points toward this conclusion, as the internal organs of the host are not injured in any way except by crowding and exhaustion of the juices. The mouth parts may or may not play some part in the function. Osmosis probably occurs equally through all portions of the skin.

An important observation by Westwood (1840) calls for more extensive studies in the future. He noticed a cord attaching the base of the abdomen to the integuments of the host and suggested that this was a tube through which food was taken by the parasite.

The writer has frequently noticed some kind of an attachment in specimens extracted by him. The female of *Halictoxenos crawfordi* has a long tube evidently arising from the base of the abdomen.

This same tube is evident in other specimens also. In Xenidæ the attachment seems to be more general and to extend some distance around the base of the abdomen. No definite conclusions may be drawn at this time.

BIOLOGICAL NOTES.

Although the complete biology of no species besides *Xenos vesparum* Nassonow, not Rossi, has been worked out, there are numerous notes which contribute greatly to the biology of the various species. These will be given by species.

MYRMECOLAX NIETNERI Westwood.

Westwood (1858) quotes John Nietner concerning this species as follows:

> The only individual hitherto met with was taken by me at an elevation of 3,880 feet in the hills of Ramboddo, Ceylon, in the act of issuing from the abdomen of a neuter of a species of ant, which had ascended a tuft of grass on an extensive pattena, or meadow, the parasite making its exit back to back from the ant. The capture was effected on the rainy afternoon of the 29th April last (1858). This being about the change of the monsoon and the beginning of continued wet weather, I consider the individual taken a late one, feeling certain that so tender an insect could, as a rule, not well make its appearance during a wet and clammy season, but rather during the preceding four months, which are dry and hot.

STYLOPS ATERRIMA Friese, not Newport.

Friese records this species from *Andrena ovina.* On December 11 at 6 p. m. a male hatched and was still alive at 8 a. m. on December 14, although dead at noon of this day, thus giving a minimum length of life of 62 hours (Friese, 1883). On February 26, 1882, at Merseburg, Germany, he took males flying about the Andrena holes between 12 and 12.30 at noon, with the temperature 8° to 9° R. (50° to 52° F.). Concerning this record he says:

> Die Thiere schwirrten mit der ihnen eigenen flatternden Bewegung an dem gegen kalte Winde geschützten Abhange der Andrena-Kolonie in langsamen Fluge hin und her, ohne dass es bei der kurzen Zeit ihres Vorhandenseins zu entdecken war, was ihr Vorhaben war, wenn es sich auch leicht vermuthen liess.

STYLOPS CRAWFORDI Pierce.

Triungulinids of this species were not taken. Although no adult males were found, male exuviæ were taken frequently between April 26, 1906, and May 1, 1906. Male pupæ were taken April 27, and 28, 1906, and from one of the two taken on the latter date an adult male was extracted.

The chronology of the collecting of this species is as follows:

Date.	Bees.		Bees parasitized.		Bees, per cent parasitized.		Parasites.				Parasites, per cent.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male pupæ.	Male exuviæ.	Female.	Total.	Male.	Female.
1906-												
April 26	0	6	0	5	0	83	....	3	3	6	50	50
April 27	8	5	3	5	37	100	1	7	0	8	100	0
April 28	19	36	12	34	63	94	2	29	16	47	65	35
April 30	15	2	4	0	26	0	....	....	4	4	0	100
May 1	20	12	4	9	20	75	....	2	17	19	10	90
May 2	18	4	1	4	5	100	....	....	5	5	0	100
May 3	32	5	4	1	12	20	....	....	6	6	0	100
May 5	18	7	2	0	11	0	....	....	2	2	0	100
May 8	1	12	0	0	0	0	....	....	......	......	......	......
May 9	11	11	1	2	9	18	....	....	3	3	0	100
May 17	4	1	0	0	0	0	....	....	......	......	......	......
May 22	3	3	0	0	0	0	....	....	......	......	......	......
May 23	2	11	0	1	0	9	....	....	1	1	0	100

STYLOPS DOMINIQUEI Pierce.

Dominique records an *Andrena flessæ* at Nantes, France, in April which contained four specimens of this species (Dominique, 1891).

STYLOPS MELITTÆ Kirby (Champion).

Between April 24 and May 5, 1900, and on May 7, 8, 12, and 13, 1899, between 7.30 and 9.30 a. m., in his garden at Woking, England, Champion took males of this species all flying in the hot sun. "Its white wings and sooty black body, as well as its peculiar rapid hovering flight, make it a conspicuous object" (Champion, 1899, 1900).

STYLOPS MELITTÆ Kirby (Chitty).

On May 2, 1900, at Faversham, England, Chitty took a male in his garden (Champion, 1900). About 10 a. m., May 21, 1902, he collected another, and records having found a bee with male exuvium in March. Concerning the flight he says: "My specimen rose and fell up and down the hedge, its wings never ceasing to vibrate until it was bottled."

STYLOPS PACKARDI Pierce.

On April 29, 1864, at Salem, Massachusetts, Packard took a male flying briskly in company with a stylopized *Andrena placida* Smith at the flowers of *Mezercon.*

STYLOPS SPENCII Pickering.

After keeping specimens of *Andrena tibialis* (*atriceps*) for twenty days in a breeding cage Smith (1875) found one that contained a male *Stylops* which shortly afterwards emerged. Enock (1875) collected

14 males and 1 female bee at Hampstead Heath, England, on April 6, containing in all 17 male *Stylops*. The captures were made between 9.40 a.m. and 12.20 p.m. The wind was southwest, the day warm; the sun was out between 10 and 11.30. He gives us the following very interesting note on flight:

> At a little before half-past 11 I saw something flying in a very peculiar manner over a broom-brush. I captured it with my net. It proved to be a male of *Stylops*. I think I should know a *Stylops* on the wing the moment I saw it. Its flight is different to anything else I have ever seen—a very peculiar, unsteady flight, something like an *Ephemera*, what I should call an uncomfortable flight, up and down, this way and that way, in fact at all angles, not keeping in one direction more than a few inches, perhaps for about 6 or 7.

STYLOPS VICINÆ Pierce.

On June 18 Packard (1864) took at Salem, Massachusetts, a stylopized *Andrena vicina* Smith, from which triungulinids were issuing to the number of 300, according to his estimate. "In their movements these infinitesimal larvæ were very active as they scrambled over the surface of the body of the parent, holding their caudal setæ nearly erect."

STYLOPS, species.

Smith (1874) recommended searching for stylopized bees between the hours of 9 and 12 in the morning, as according to his experiences the stylops always emerged from the body of the bee on the day on which the latter first quitted its nest, should the day be bright and sunny, and he also mentioned the fact of his never having captured a bee which had a male stylops remaining in its abdomen at a later hour than 12 m. He had himself bred stylops five or six times and had never done so later than the month of April, always having captured the attacked or infested bees early in the day. Saunders (1874) remarked that he had once found a number of bees in the afternoon at dusk, some of which contained male stylops, but that on that occasion the morning had been wet and dull, and therefore the bees had probably only just made their appearance.

Friese (1906) records capturing male stylops on the wing at Strassburg, Germany, April, 1888; Bozen, Germany, July 8, 1896; and three individuals at Schwerin, Germany, on May 4, 1885.

Thwaites (1841) says:

> On May 6, '38, caught a *Stylops* flying, and on the Tuesday following saw at least twenty flying about in a garden at Kingdown near Bristol, but so high from the ground that I could capture only about half a dozen. Since that time they have become gradually more scarce, and to-day, May 12, I have not been able to see one.

He says further:

> The little animals are graceful in their flight, taking long sweeps, as if carried along by a gentle breeze, and occasionally hovering at a few inches above the ground. Their term of life seems to be very short, none of those I have captured living above five hours.

HYLECHTHRUS RUBI Saunders.

Concerning this species Saunders(1852) contributes a very valuable description of the exsertion of the head of the male from *Prosopis rubicola versicolor:*

> I have not unfrequently been enabled to detect the eye shades of the parasite before the *Hylæus* nymph has discarded its pellicle, working to and fro beneath the dorsal tegument; although more conspicuous when the bee first attains the imago form, the head of the parasite being then seen turning from side to side, and steadily pressing all the while upon the rostrum, as the axis about which it revolves, in the ratio of one-eighth of a circle, for the purpose of introducing this between the abdominal folds. Thus when one eye shade advances the other recedes, both being carried deeper below, when the great strain appears to operate upon the upheld rostrum. As soon as the lodgment is effected, this is gradually pushed forward by a continuation of the same process, until sufficiently advanced, the entire operation occupying from one hour in some cases, to two hours in others, and immediately following the ultimate transformation of the bee in its then moist state; after which the parasite remains perfectly motionless. I have sometimes seen parasites thus engaged simultaneously within the same *Hylæus;* and should the attempt not prove successful, the locality is changed for the segmental division next in succession; or, if foiled again here, the parasite sometimes remounts to the preceding one. These efforts have been continued for upward of an hour after a newly developed imago *Hylæus*, within which the eye shades were discerned, had been emersed in spirits, until at length the parasite appeared to have attained the extreme verge of the segmental threshold ere its career was finally arrested.

At the moment of protrusion the male head is white except the eye shades, but in a few hours the puparium assumes a light castaneous hue. The ordinary period for quitting the pupa-case would appear to be the eighth day after the first protrusion.

> After the first burst, produced apparently by the parasite pressing forcibly against the operculum, the head and shoulders being instantaneously protruded on this falling off, a slight effort suffices to liberate the pseudelytra and first pair of legs; when all these organs idly beating the air and agitating incessantly, much exertion is made to effect a passage for the second pair of legs, where the principal detention occurs; after which a few jerks up and down speedily serve to release the metathorax and abdomen; the imago forthwith winging its flight toward the light.

Saunders never succeeded in keeping the males alive beyond the day of exit and rarely more than two or three hours. However, during this brief life they may exert great strength, for one male was seen to draw around the body of its dead host and two other males which later came out.

HYLECHTHRUS QUERCUS Saunders.

In an unpublished manuscript Saunders estimates the term of gestation at from three to four weeks. He found triungulinids on June 3.

HYLECHTHRUS SIEBOLDII Saunders.

Saunders records triungulinids on July 5.

HYLECHTHRUS, species.

The males emerged from the pupa case with the dorsal side up. The puparium is oriented in the same manner (S. S. Saunders, 1852).

ACROSCHISMUS BOWDITCHI Pierce.

Mr. Dury raised a male from a male host in capitivity ten days on September 16, 1905, at 7 a. m., and on September 22, 1905, one emerged from a male host which had been in captivity two weeks. His records show that 2 males emerged prior to August 24, 4 prior to September 13, 5 prior to September 16, 3 on September 16, 1 on September 22, 2 prior to September 27. He also took 2 male pupæ on June 15, and 4 on July 3.

ACROSCHISMUS PALLIDUS Brues.

The time required for males to reach maturity after the wasp emerged varied from about ten to seventeen days, the pupa cases not being protruded between the abdominal segments until several days after the latter left its pupal cell. Brues (1903) bred 24 males in May.

Data were also gathered by the writer concerning the stage of development of this species. On September 23, 241 parasitized wasps were killed by an overdose of anæsthetics in collecting the nests. These wasps had 338 parasites, of which 26 had emerged, 76 females were mature, 188 males were in the pupal stage, 40 female larvæ and 8 male larvæ were in the bodies of the hosts.

On October 9, 16 dead male parasites and 10 alive males were found in the breeding cage; 9 parasitized wasps were dead, from which 3 males had emerged, and in which were 10 adult females and 25 male pupæ.

On October 10, 1 male matured; on October 12, 1 male; October 13, 3 males. On this last date 5 wasps were dead, from which 8 male parasites had emerged, and in which were 2 adult females and 1 male pupa.

On October 14, 3 males matured. On October 16, 2 wasps were dead, from which 3 male parasites had emerged, and in which was 1 female adult.

Of the wasps kept alive since September 23, 34 male parasites have emerged, and yet on October 16 all of the wasps which have died have had but 19 empty puparia.

On October 27 a final count was made of the dead and alive wasps. Eighteen wasps were dead, from which 21 male parasites had emerged, and which contained 23 adult females and 2 male pupæ; 11 parasitized wasps were still alive, from which 5 male parasites had emerged, and in which were 10 adult females. These wasps lived at least a week longer (but were not carefully observed). From five, it appears that the male parasites had been out thirteen or fourteen days.

A summary now shows that since September 23, 34 parasites emerged, and yet the wasps contained 43 empty puparia, which indicates that the wasps containing 4 of these empty puparia lived thus from before September 23 until about October 9, while those containing the remaining five died between October 9 and October 13, thus showing a possibility of living over sixteen days with an empty puparium in the abdomen. Brues (1905, 293) comments on the remarkable fact that 7 wasps were captured in the field with empty puparia. These data given above should dispel any further doubts as to the ability of the wasps to live after the exit of the parasites.

An examination of 2 wasp larvæ on September 28 showed no parasites; in 10 wasp pupæ but 1 female parasite was found; in 10 teneral adults 2 female parasites were found. It would seem that the parasitized wasps had developed most rapidly, or that the period of triungulinid activity ceased before the last eggs were deposited.

An attempt to hatch male parasites from dead wasps failed. A pupa removed from its host remained alive at least two days, but the adult did not mature. This experiment demonstrated the presence of a liquid surrounding the pupa in its puparium.

As to the time of day, the author had one emerge at 2.32 p. m. on October 10; one in the p. m. October 12; at 12.10, 12.20, and 12.26 on the 13th, and at 8.50, 9, and 10.5 on the 14th.

Several observations were made upon the longevity of this species. One found at 2.32 lived until 4.13; one found at 12.26 immediately after emergence lived until 3.15; one found at 9 a. m. lived until 2 p. m., and one lived from 10.05 until 2. Thus five hours was the longest any were kept alive. In this period a great distance could be covered and there can be little doubt but that most of the males fulfill their mission.

On October 13, 1905, the writer had an opportunity of watching the activities of a male almost from the moment of its exit. None were ever seen in the act of emerging, however. The life of the insect was divided into distinct periods: First was the period of violent, feverish activity, succeeded by an even longer period of nervous quietude, then by a few minutes of violent struggle, and finally a collapse and a diminishing nervous quivering.

During the period of activity the buzzing was very distinct at several inches distance. The wings and elytra are in constant and very rapid vibration even when the insect is not flying. The noise is made by the elytra. The antennæ move constantly, the two branches being capable of separate movement. The abdomen moves a great deal, bending down and forward (thus giving added weight to my comment on fertilization). The entire body is a-quiver, especially the tarsi. During this period I noticed no movement of the mouthparts.

Before it had lived an hour the sound became very diminutive, and finally the wings ceased to vibrate. Occasionally, however, considerable movement was manifested.

When about two and a half hours old a violent movement took place for several minutes, which involved mainly foot action. The antennæ, mouthparts, elytra, and body were combed in quick succession by the legs, and finally the insect lost all power of retention of its foothold. It partially regained this, however. It was then that I was able to see a distinct movement of one of the mandibles, and to observe that each part of the thorax was capable of movement by virtue of the elastic yellow commissures uniting the chitinous parts. This was especially true of the prothorax. The abdomen at the end of this period had shrunk to one-half of its original length.

The final period consists of a faint quivering of legs and antennæ, the insect being upon its back.

From these observations several important points may be deduced.

1. The independent movement of the antennal branches indicates that the antennæ form a very important function in the life of the insect.

2. The downward and forward movement of the abdomen indicates that the fertilization takes place with the male in an erect position as recorded for *Crawfordia pulvinipes*.

3. Although not stated in the preceding paragraphs, it was noted that the last two pair of legs assumed the greater part of the burden of supporting the body.

4. The reason for the insects keeping up a constant buzzing sound throughout the active portion of its life must remain unexplained.

5. The presence of innumerable sense bodies on the antennæ indicate to the writer the probability that these organs can detect the presence of the host insect by its sound, or perhaps of the female parasite by its odor.

6. The violent combing of antennæ, mouthparts, elytra, and body would indicate a highly sensitive integument, and suggest that perhaps the maxillary palpi at least also serve as sensory organs.

7. The movement of the mandibles proves them to be not entirely useless. The palpi must have some function, as they are never in two specimens placed in the same attitude.

8. The presence of elastic commissures between the head and three thoracic segments would indicate a line of descent direct from the Thysanura with all of the antecedents lost. This point is strengthened by the passing through the Campodeoid type in the larva. The

immense reduction of the prothorax in *Anthericomma barberi* shows how far specialization has gone within the order itself.

ACROSCHISMUS HUNTERI Pierce.

Triungulinids of this species were found in a parent collected at Victoria, Texas, June 26, 1906, by C. R. Jones. An adult male in its puparium was found September 25, 1906, by J. C. Crawford.

XENOS VESPARUM, Authors.

Nassonow (1893) writes that he found triungulinids in the nests of *Polistes gallica* at Cairo, Egypt, in the middle of March. Saunders (1852) took a female wasp with three prolific female parasites about the middle of July. The same author found that the triungulinids "are enabled to leap to the distance of full half an inch, but by what means this movement was effected" he could not determine. They refused to attack either ovum with inactive embryo or ovum with larvæ attempting to escape, but very readily attached themselves to larvæ of moderate dimensions, affixing both head and tail like leeches. Experiments with three triungulinids fixed the limit of the hexapod stage.

Date.	Larva 1.	Larva 2.	Larva 3.
July 18, 2 p. m.	Affixed	Affixed	
July 18, 3 p. m.			Placed on host.
July 18, 5 p. m.	Completely buried		Half buried.
July 19, a. m.	Completely out of sight	Completely buried	Completely out of sight.
July 19, p. m.		Out of sight	
July 24	Hexapod still	Hexapod still	Had just molted—apodous.

Thus the hexapod stage parasitic is approximately six days.

When in the host the males have the ventral side turned away from the body of the host.

EUPATHOCERA LUGUBRIS Pierce.

A male was bred by Mr. Dury at Cincinnati, Ohio, from *Sphex extremitatus* on August 30, 1905. On September 3, 1905, this species or a close congeneric species was bred by him from *Sphex fragilis* at 1 p. m. On October 2, 1901, a female wasp was taken with an empty puparium.

OPHTHALMOCHLUS DURYI Pierce.

Mr. Dury bred males of this species from *Priononyx atrata*, at Cincinnati, Ohio, on August 16 and 19, 1901. In the latter case the host had been dead three days. As late as September 21, 1901, he took a wasp with a male pupa. A female parasite was taken on June 17, 1900, and on September 21, 1901, a female with triungulinids was captured. Thus the inference may be drawn that there is a continuous series of breeding through the summer, or at least a double brood.

PSEUDOXENOS HEYDENII Saunders.

Saunders (1852) records triungulinids of this species on July 13 and August 9. These young he found to have distinct saltatorial powers. The males emerge from the puparium with the ventral side up, although the puparium is oriented, as in *Hylechthrus*, with the dorsum up. The only date of maturity for the male is July 13.

ELENCHUS, species.

Green (1902) captured a male corresponding almost exactly to the figure of *Elenchus tenuicornis* at night in an acetylene-gas moth trap at Paradeniya, Ceylon. This record is worthy of thoughtful consideration.

ELENCHOIDES PERKINSI Pierce.

Muir (1906) says the males hatched out in the breeding jars between sunrise and 7 a. m. and were dead by noon.

> They are very feeble upon their legs and keep their wings in rapid vibration all the time they are walking. When on the wing they take up a perpendicular position with their antennæ erect and the tip of their abdomen turned slightly under. Sight seems to be the chief sense by which they detect the presence of the leaf hoppers, as I have seen one hovering along one side of a leaf with half a dozen stylopized hoppers on the other side, only a quarter of an inch away, and apparently not knowing of their presence, but should a hopper but show its antenna over the edge of the leaf the *Elenchus* darts toward it and hovers over its back.

INTERNAL STRUCTURE.

In their internal structure the Strepsiptera exhibit several striking peculiarities, and throughout show high specialization. This part of the paper must necessarily be drawn mainly from the excellent articles by Nassonow, which, being in Russian, are inaccessible to most English-speaking entomologists. So well, however, has his work been done that one not cognizant with the language may yet gain much information from the plates. The writer has fortunately had access to a complete English translation of one of the articles and with the aid of a dictionary has been able to gather the meaning of his other plates and in some places of his text. If important observations are overlooked or the plates misinterpreted, it is due to the writer's inability at present to grasp the science of the Russian language.

ALIMENTARY SYSTEM.

The triungulinid is so minute that the character of the intestinal canal could not be studied, but in the first parasitic instars it may be observed. It is then a straight tube passing through the body and consisting of a short gullet, passing into an œsophagus, which dilates into a crop. Thence it is greatly extended as the stomach and terminates in the very short intestine. At about the fourth instar the *gullet* lies nearer the ventral surface of the head as a short, somewhat flattened tube, coated inside with chitin. The walls are lined with strong muscles, circular, longitudinal, and others directed to the walls of the head. The longitudinal muscles pass along the dorsal side only. Four dorsal muscles distend the gullet and are directed sideward and forward, being counteracted by two of the more numerous ventral muscles, which extend sideward and backward. A large number of fibers extend forward to the anterior region of the head. The *œsophagus* has a very slightly developed longitudinal and circular musculature, and on its external surface bears numerous one-celled glands, probably salivary. The *crop* is expanded cone-shape posteriorly, its walls consisting of cylindrical epithelium coated inside with chitin. On the outside a continuation of a weakly developed muscular layer from the œsophagus is observed. As the larva develops the gullet expands and the crop contracts, no longer forming a separate section. The *stomach,* or *middle intestine,* extends from the second thoracic to the eighth or ninth abdominal, but is not distinctly demarked from the crop. At its beginning the stomach is somewhat narrowed. Then it forms a cylindrical tube, which is strongly narrowed posteriorly, ending blindly. The musculature is very slightly developed and consists of ramified fibers sparsely situated on the surface of the stomach in the slightly developed membrane of connective tissue. The epithelium consists of very large cells, which stand out into the cavity of the intestine in the form of hemispheres, or sometimes flask shaped, narrowed at base. Each cell has large-grained protoplasm with nucleus and nucleolus, and is in texture fibrous to reticulate. As the larva develops smaller cells arise at the bases of these large cells, also bearing nucleus and nucleolus. The large cells dwindle, disintegrate, and finally drop out into the intestine. At the same time the small cells increase. In the pupal stages none but minute cells remain. The *posterior intestine* is very short and of very simple structure. At the first it has a conical form, is somewhat flattened from the ventral side to the dorsal, and opens outside on the dorsum of the last segment with an anal opening in the form of a transversal slit. Its walls consist of cylindrical epithelium and are coated inside with chitin. Toward the end of the larval life the intestine somewhat increases in length and assumes a cylindrical form, slightly narrowed at the anterior end. It is cylindrical in the pupa also (Nassonow, 1892 *e*, pl. 1, fig. 23; pl. 2, figs. 1, 2, 4, 6).

In the female the canal has at first the same structure as that of the male. It later differs by the intestine becoming atrophied and the posterior end of the stomach being connected with the outer coverings of the last abdominal segment by means of an epithelial band at the point corresponding to the position of the anal opening. Subsequently this band is apparently resorbed. The anterior intestine becomes flattened from the ventral side to the dorsal and is of uniform bore. The stomach becomes narrowed, and laterally flattened, and a change of epithelium takes place as in the male (Nassonow, 1892 *e*, pl. 2, fig. 17; 1892 *c*, pl. 1, fig. 9).

Malpighian vessels have not been observed in the larval stage, although rudiments probably corresponding to these vessels were found at the end of the male larval stage. At the anterior end of the intestine of the larva protrudings from the dorsal wall begin to form, three in number, spherical, and situated in one row. (Nassonow, 1892 *e*, pl. 2, figs. 9 *e*, 14 *e*.) They are close together and afterwards fuse at their bases and communicate with the cavity of the intestine by one opening, at the same place elongating into blind excrescences (Nassonow, 1892 *e*, pl. 2, fig. 10 *e*). These excrescences become larger at the pupal stage, split up, and appear as if anastamosing with one another. Thus the place of the connection of the excrescences also increases in length and forms a canal by whose means the cavities of the ramification communicate with the cavity of the intestines. This common canal is somewhat expanded at the middle (Nassonow, 1892, pl. 2, figs. 7, 11).

Nassonow assumes that these formations may correspond to the Malpighian vessels by reason of the mode of origin and location.

NERVOUS SYSTEM.

The nervous system in the first days of the parasitic life is very strongly concentrated. The brain, consisting of two large ellipsoid ganglia, extending longitudinally, lies in the first and second thoracic segments. The commissures pass off from the anterior ends of the lobes and extend ventrally to the abdominal mass of ganglia. Optic nerves pass to the ocelli from near the same point. No optic lobes are differentiated. The abdominal mass consists of a fusion of the subœsophageal, thoracic, and abdominal ganglia into one large mass situated in the thoracic and first three abdominal segments (Nassonow, 1892 *e*, pl. 2, figs. 1, 2, 3, 4).

As the larva develops the lobes of the brain tend to become transverse, the ocular lobes begin to form, and the ocelli gradually disappear. The circumœsophageal commissures become more slender while the abdominal ganglion lengthens and becomes constricted at its middle. This constriction becomes greater until the huge ganglion is divided into two smaller ones, the first or "thoracic" lying partly in each of the three thoracic segments, and the second or "ventral" lying in the second and third abdominal segments, and later only in

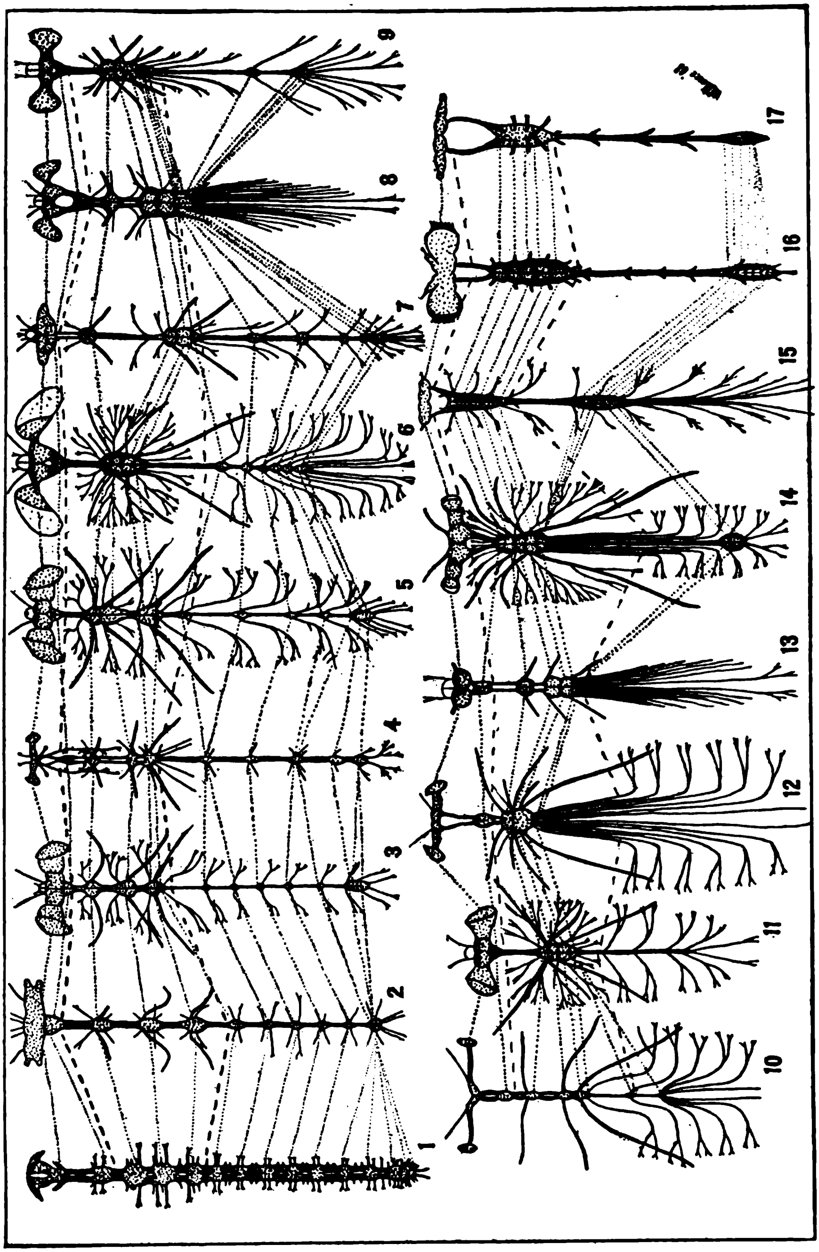

Fig. 2.—Diagram comparing nervous system of Strepsiptera with that of other orders.

1. *Machilis maritima.*
2. *Termes*, species.
3. *Chironomus plumosus.*
4. *Melanoplus spretus.*
5. *Empis stercorea.*
6. *Tabanus bovinus.*
7. *Formica rufa.*
8. *Acilius sulcatus.*
9. *Syrphus ribesii.*
10. *Lucanus dama.*
11. *Sarcophaga carnaria.*
12. *Lachnosterna fusca.*
13. *Melolontha vulgaris.*
14. *Stylops melittæ.*
15-17. *Xenos vesparum.*

(These figures are borrowed from Packard, Brauer, and Nassonow and for detailed information see list of Illustrations.)

the third segment. From the thoracic ganglion nerves pass to the three thoracic segments and first abdominal. The second, third, and fourth abdominal are reached by nerves from the sides of the ventral ganglion and the remaining segments by nerves passing back from the apex of this ganglion (Nassonow, 1892 *e*, pl. 2, fig. 16) (fig. 2, no. 15, p. 60).

In the adult male the central nervous system has been worked out for two species. In *Xenos vesparum* Rossi (Nassonow) the brain seems to be composed of four prominent lobes or divisions. The lateral or optic lobes are constricted at base and almost spherical; the inner or antennal lobes are also constricted in front, and point diagonally outward. From behind the antennal lobes arise the circumœsophageal commissures, which pass down and back to the thoracic mass, which is formed by the fusion of the three thoracic and first two abdominal pairs of ganglia. From this mass pass out nerves to the three thoracic segments and to the first three abdominal segments. From the abdominal commissure pass off nerves to the following four segments. The ventral mass is composed of seven distinct pair of ganglia, and from it pass off nerves to the last three abdominal segments (Nassonow, 1892 *c*, pl. 2, fig. 16) (fig. 2, no. 16, p. 60).

In the male of *Stylops melittæ* Brandt, not Kirby, the brain consists of a very transverse mass, one-third of which on each side is the ocular lobe in the form of a cylinder slightly enlarged toward its apex. The two central or antennal lobes are more globose, but not prominent. From these pass the antennal nerves in front and the circumœsophageal commissures behind. The thoracic mass is composed of five pair of ganglia, from which pass large nerves to the legs. This mass is located in the last two thoracic segments. From the back of the thoracic mass four pair of independent nerves pass to the first four abdominal segments. The ventral mass is located in the fourth and fifth segments and, according to Brandt, is composed of only two distinct pair of ganglia. From this mass the remaining segments are supplied (Brandt, 1878) (fig. 2, no. 14, p. 60).

In the female of *Xenos vesparum* (Nassonow) the nervous system does not traverse as much of the body as in the male. The cephalic ganglion is narrow and transverse and apparently of six lobes tapering toward the ocular lobes, which reach only halfway to the sides of the head. The thoracic ganglion lies in the posterior half of the cephalothorax and gives off two pairs of nerves to the thorax and one pair to the abdomen. One pair of nerves arises at the apex of this ganglion and three other pair arise from the ventral commissure. The ventral mass, consisting of at least six pair of ganglia lies in the third and fourth segments and from it pass off nerves to the remaining segments (Nassonow, 1892 *c*, pl. 1, figs. 9, 10, 14; Nassonow, 1897) (fig. 2, no. 17, p. 60).

TRACHEAL SYSTEM.

So far as known the Strepsiptera have one pair of spiracles located in the posterior part of the metathorax, on its dorsal surface, in young male larvæ, but moving forward with increasing age. In *Acroschismus* the spiracles seem to be located in the mesothorax on the pleuræ (see Mesostigmatal lobe, p. 65.) In male pupæ they are arranged on a separate elevation (Nassonow, 1892 *e*, pl. 1, fig. 27 *b*). In the females the spiracles are often very prominent and under a microscope the direction of the tracheæ can be traced. The stigmatal trachea is short, being divided in the first abdominal segment into three main tubes. The first tube to branch off is the cephalothoracic, which passes forward and unites with that on the other side under the intestinal canal and behind the brain. The side branches of this tube supply the legs, wings, thoracic muscles, anterior intestine, and thoracic ganglion. The connecting tube supplies the muscles of the head and the brain.

The abdominal main tubes arise from the main stigmatal trachea and pass backward, one dorsal and the other ventral. The first abdominal segment is supplied by tubes arising at the separation of these two main trunks. The two tubes supply the abdominal muscles, and all organs lying in the second to eighth segments. The two tubes are reunited between the seventh and eighth. The ninth and tenth segments are supplied by two tubes arising at the union of the main tubes (Nassonow, 1892 *e*, pl. 2, fig. 16; Nassonow, 1892 *c*, pl. 1, fig. 14).

REPRODUCTIVE SYSTEM.

In the larvæ the sexual organs are practically alike in both sexes, consisting of longitudinal cylinders lying in the abdominal segments along the sides of the intestinal canal nearer to the ventral surface of the body. From the apices of these glands arise mesodermic bands directed to the lower side of the outer covering of the ninth abdominal segment (Nassonow, 1892 *e*, pl. 2, figs. 2, 4, 16).

In the male this mesodermic band becomes hollow and. funnel shaped at its base, although cut off from the gland by a layer of cells. The two bands approach, and form a pear-shaped blind sac which later finds an exit through the ninth segment. During the pupal stage the partition between the glands and ducts is resorbed. The development continues by reducing the length of the ducts until, in the adult, the vesicles empty almost directly into the ductus ejaculatorius (Nassonow, 1892 *e*, pl. 2, figs. 8, 9, 10; Nassonow, 1892 *c*, pl. 2, fig. 11).

In the female the rudimentary glands become broken up and the egg masses lie throughout the body cavity. Median invaginations of the ventral surface occur in the female beneath the cuticle of the pupa on the second to the fourth, fifth, or sixth segments. These invaginations deepen until they become long, funnel-like tubes, and finally the inner end breaks, and through the canals thus formed the triungulinids find exit into the brood canal which opens between the head and thorax on the cephalothorax (Nassonow, 1892 *e*, pl. 2, figs. 18, 19, 20, 21; Nassonow, 1892 *c*, pl. 1, figs. 9, 11, 12). The number of these median canals seems to be variable. In *Xenos vesparum* (Nassonow) Nassonow found four only (Nassonow, 1892 *c*, pl. 1, figs. 2, 9). In *Stylops melittæ* (Nassonow) he found five (Nassonow, 1893 *a*, pl. 1, fig. 2; pl. 2, figs. 1, 6, 9). Muir found only three in *Elenchoides perkinsi* Pierce (Muir, 1906).

EXTERNAL STRUCTURE.

MALE.

The integument of the male Strepsiptera is of a very thin chitin, in many parts transparent, and very soft in all parts except the mandibles and œdeagus.

The head is transverse, with the eyes more or less stalked. The eyes are composed of numerous hexagonal or circular ommatidia separated from each other by densely ciliate walls. Such a condition occurs also in *Æolothrips* (Thysanoptera) and in *Trichobius* (Pupipara) and in common parlance might be known as a "raspberry eye." The eye partitions extend inward and separate the ommatidia as far as the brain (Nassonow, 1892 *c*, pl. 1, fig. 16). Ocelli are absent (see pl. 1, fig. 9).

The antennæ arise in front of the vertex between the eyes. They are invariably flabellate in the third joint, and may or may not have the succeeding joints produced. The entire structure of the antennæ is very sensitive and may be described as follows: The surface is divided off into somewhat circular areas by stout, curved bristles, with broad bases, which fence into each area a subcylindrical tent of very transparent membrane surmounting a circular opening into the interior of the antennæ. These tents are evidently highly sensitive organs for communicating the necessary impressions to the transient male. In Xenidæ the areas are much denser and more closely guarded than in the Elenchidæ. In the Mengeidæ the tents are not as delicate, resemble tubercles, and bear the spines instead of being circled by them. (See fig. 3 on p. 69, nos. 2, 4, 6, 7, 8, 10, 12, 14, 16.)

The mouth parts are still very difficult of elucidation. A view of the face shows a triangular or circular opening bounded by the narrow genæ and the vertex but open behind. At the base of this pit is a narrow, transverse strip adjoining the prothorax and covered at each side by the overhanging genæ. This strip, it seems to the writer, must be all that remains of the base of the occiput, gula, and labium.

In front of this there arises under the gena, at each side, a generally two-jointed appendage. This can be no other than the maxilla, of which the first joint is the palpiger and the second the palpus. This is as held by Savigny (Newman, 1850). In *Crawfordia pulvinipes* the maxilla is three jointed, the first two joints being somewhat slender, and the third elongate and broadly flattened, paddle-shape. In front of the maxillæ arise the mandibles, slender, curved, scimitar-like appendages, generally transparent, chitinous, but in Halictophagidæ membranaceous, villous, and very short. Beneath these appendages is an integument which arises crater-like in front of the crossed mandibles and forms the mouth opening. In the mind of the writer all of this flared surface is the pharynx, which lies exposed in the absence of labrum and labium and of broad appendages to cover it. It can hardly be called the labrum and labium mortised together because the appendages arise above it and below the genæ. (See pl. 5, fig. 11; pl. 13, figs. 10, 13.)

The thorax is by far the largest part of the body. The prothorax is never more than a narrow ring sufficient to bear the legs, and yet in *Anthericomma barberi* this part is resolved externally into a pronotal and prosternal disc around which the mesothorax has grown and become contiguous with the head laterally. The prothorax is connected with the head by an elastic band. It is composed of two more or less distinct transverse dorsal pieces, a very narrow pleural piece on each side and two ventral pieces feebly separated on the median line. From the latter the legs arise with the cavities open behind (Nassonow, 1892 *c*, pl. 2, figs. 2, 3, 4). (See pl. 14, fig. 5.)

The mesothorax is likewise separated from the prothorax and its component parts are more or less separated by elastic commissures. Dorsally the chitinous part consists of a narrow transverse band, a larger arched band inclosing posteriorly another curved band. The pleural piece is somewhat oblique and bears the elytra. These appendages are nothing more than bulbous clubs, sometimes ladle-shaped. The mesosternum consists of a broad piece behind which lies a spindle-shaped piece divided on the median line. The legs are attached to the apical side of this with the coxal cavities open behind.

Below the elytra on the mesopleuræ, or outer edges of the mesosternum, in species of the genus *Acroschismus*, a small but prominent lobe arises which protrudes from the sides of the body, inclining forward. This lobe is rather oblong, rounded, and in length about equal to the breadth of the elytron at its base. The upper or dorsal surface is convex, the ventral surface excavated and channelled inward to an opening into the body. This opening the writer takes to be the stigma, after consultation with Doctor Ashmead, Mr. Schwarz, and Mr. Heidemann. The entire structure seems to be analogous to the metasternal groove found in Heteroptera, which Stal, in the "Enumeratio Hemipterorum," in his classification of the Pentatomidæ, calls the "sulcus;" which Uhler, 1878, in his "Summary of the Cydnidæ of North America," calls the "ostiolar canal;" which Signoret, 1883, in his "Group des Cydnides," calls the "canal ostiolaire;" and which Schouteden, in the "Genera Insectorum," speaks of as the "orifice" in the Pentatomidæ. This organ may be known as the mesostigmatal lobe. (See pl. 6, fig. 4.)

While observing the activities of a male *Acroschismus pallidus* the writer noted that the characteristic buzz continued as long as the elytra were in motion and ceased when they became quiet. At the ventral base of the elytra is a hook-like projection which is very close to the mesostigmatal lobe. Whether this lobe and hook play some part in the noise-making is of course merely conjectural, but perhaps possible.

The metathorax is much more complex and occupies nearly one half of the length of the body. On the dorsal median line may be differentiated four distinct parts. The basal piece is subtriangular or keystone shaped. It is the *præscutum* of Audouin and Westwood, and known to Kirby and Saunders as the "scutellum." The second piece is similar in shape but reversed so that the two form a sort of spindle. This is the *scutellum* of Westwood, known to Audouin as the "scutum," and to Kirby and Saunders as the "interlumbium." The third piece is oblique or vertical, transverse, and corneous or membranaceous. It is the *postlumbium* of Kirby, Westwood, and Saunders, and the "scutellum" of Audouin. The apical piece is produced conical, convex, covering the base of the abdomen and beneath concave. It is *postscutellum* of Audouin and Westwood, and the "proscutellum" of Kirby and Saunders. Very unfortunately the writer did not translate the explanation of Nassonow's plate (Nassonow, 1892 *c*, pl. 2) dealing with these structures, otherwise these parts might be named more correctly. At the sides of præscutum and scutellum are the *lumbi* which together form the *scutum*. These were known to Audouin as "epimera." Behind the lumbi and at the side of the postscutellum are the *femoralia*. Kirby and Saunders have distinguished below the lumbi a longitudinal, sublanceolate piece, the *pleura;* a second parallel piece to the base of which the wing is attached, the *parapleura;* this piece lying between the base of the wing and a small piece known as the *scapula*. The metasternum is also variously divided, but no particular names have been given the parts. (See pl. 6, figs. 6, 7.)

The wing venation is simple, radial. The wings folded longitudinally only. A node is sometimes present on the costal margin, as, for instance, *Apractelytra schwarzi*. The most generalized wings have eight primary veins (Xenidæ), which become reduced in number to five in the Elenchidæ. As Saunders worked out a system of nomenclature for the veins his names will be given in parenthesis following those herein adopted. The *costa* (*neura costalis*) arises at the base and follows the edge, being sometimes interrupted by the node. The *subcosta* (*neura mediastina*) is a light vein immediately beneath and terminating at the node. The *radius* (*neura postcostalis*) is often very stout. It is sometimes interrupted at the node, and in one case a very fine vein was noticed branching off at this point of interruption (*Apractelytra schwarzi*). This little vein is evidently the first branch of the radius, and the one most ordinarily seen is the second branch of the radius. The *costal area* (*area costalis*) lies between the radius and costa and is very much more heavily pubescent than the remainder of the wing. The next primary vein is the *medius* (*neura externomedia*) and it is the last arising from the costal stalk of the trachea. Between the radius and medius there often occur one or two detached veins evidently belonging to the medius. These are the *first and second branches of the medius* [*neura 1a insulata* (*apicalis*) and *neura 2a insulata* (*discoidalis*)]. In some cases the fourth branch of the medius is found below the medius and entirely unattached. The *median area* (*superior*) lies between the medius and cubitus. The *cubitus* (*neura subexterno media*) arises from the anal stalk. This is followed by the *first anal* (*neura internomedia*), *second anal* (*neura subinterno-media*), and *third anal* (*neura analis*). One or more of these are often absent. The *anal area* (*inferior*) is comprised between the cubitus and posterior edge (*margo analis*). Saunders called the part between the third anal and anal margin the area analis.

The legs are isomerous. The front and middle coxal cavities are open behind, while the posterior are closed. The anterior and median trochanters are long and transverse and the posterior rather short. The femora are rather stout, the tibiæ slender. The tarsi are two to four jointed and without claws or five-jointed and with two claws (Mengeidæ). Each tarsal joint is provided beneath and appendaged apically with a delicate adhesive pulvillus clad with curved hairs, except in the Mengeidæ and Myrmecolacidæ, in which the first two or three joints are cylindrical. (See fig. 3, on p. 69, nos. 1, 3, 5, 9, 11, 13, 15.)

The abdomen is composed uniformly of ten segments, although the form of some of these segments is subject to variation. Nassonow (1893) first worked out the true relations of the abdomen by following the younger stages up. He found that the tenth segment bearing the anal pore was ventrally surpassed by the ninth segment bearing the genital pore. The writer's study of *Acroschismus hubbardi* results in the following description: The tenth segment (the *podex* of Kirby) as a sort of suranal flap overhangs the projecting, concave ninth segment (*hypopygium* of Brues), which at its apex is cleft, forming a claw on each side of the base of the oedeagus or genital sheath; the genital sheath is formed by the complete fusion of the paramera into a sinuate tube, reflexed and lying within the concavity of the segment, and with its tip sharply turned upward; near the base of the last curve on the inner angle of the oedeagus is a little pore through which the very slender penis may be exserted. Such a condition is very nicely illustrated on a slide in the author's collection. (See pl. 5, fig. 8; pl. 6, fig. 9.)

The shape of the oedeagus must be considered of generic and specific value, as it is one of the very few chitinous organs of the body which are not subject to change on drying. In *Crawfordia* it is slender at base, then suddenly inflated, and as suddenly reflexed and narrowed, apically acute. In *Stylops crawfordi* it is peculiarly notched. In *Apractelytra* it is a sinuate tube of about equal length almost to the tip, which is obtusely angled. In *Acroschismus*, *Pentoxocera*, *Trioxocera*, *Mecynocera*, and *Elenchus* the tube is somewhat enlarged basally, suddenly turned, at various angles, apically, and very acute.

The tenth abdominal segment is large in *Acroschismus* and very small in *Pentoxocera* and *Anthericomma*.

In studying characters of such interest it is always important to find analogies among other insects. In this the writer relied upon the vast storehouse of information possessed by his honored preceptor, E. A. Schwarz. The Psyllidæ as shown by Witlaczil and Löw (1876, and numerous other papers) have the eighth, ninth, and tenth segments placed in relatively the same manner as in the genus *Acroschismus*, but with the penis lying free between the ninth and tenth and not attached to the ninth to its apex as in Strepsiptera. The "*genital zange*," or claspers are greatly developed. The penis in Psyllidæ is two jointed. It is not known definitely whether this organ is really the penis or only the oedeagus. The genus *Corphyra* Say, formerly of the Anthicidæ, is shown by Horn (1883) to have the exposed oedeagus composed of partly or entirely separated paramera between which lies the penis. These paramera take various forms. Mr. Schwarz showed the writer how the specialization of the abdominal segments is carried to a remarkable extent in the genus *Malthodes* of the Telephoridæ.

FEMALE.

So little is known of the female Strepsiptera that it is very difficult to discuss this general question. It is not because they are scarce, because the females are the most generally met with, but because they lack salient features. In the descriptive matter to follow will be found the main results of the writer's study of this subject, which by force of circumstances has been the last to be studied. (See pls. 3, 4, 9, 11, and 12.)

The stylopid, xenid, and hylechthrid heads occupy only a small apical portion of the cephalothorax. The mandibles in all three families are somewhat prominent. In the Stylopidæ rudiments of another pair of mouth parts are discernible. The shape of the mandibles furnishes a good character in these families. The transverse slit is generally curved with the bow forward. It is never very wide. The shape of the entire cephalothorax is a valuable character. The character of the metasternal spiracle also furnishes great aid.

The Halictophagidæ and Elenchidæ form another grouping. In these the mandibles do not appear at all. The cephalothorax appears as a disk with several lobes and a transverse slit. In Halictophagidæ the lobes are still apical. The transverse slit is much farther back than in the preceding families and in most of the genera is merely a slit, but in *Agalliaphagus* a very considerable area is depressed, causing a deep emargination of the head. In the Elenchidæ the lobes are all ventral and considerably removed from the apex. In *Deinelenchus* these areas are very prominent and the transverse slit is narrow transverse. In *Mecynocera* the areas are obsolete and the transverse slit becomes a very large area, causing a deep emargination of the thorax. A thin transverse veil extends forward over the cavity from the thoracic edge of the slit.

CLASSIFICATION.

The writer has based his system of classification upon the following considerations:

1. Four types of tarsi and seven types of antennæ occur in the order as known at present. Each of these types of antennæ the writer considers of family value. At first it seemed that the antennæ should be used as the first character, because of the importance of their function in perpetuating the species. The coordination of characters finally compelled an alteration of the scheme, following Perkins's (1905) lead.

2. It was found that as the number of tarsal joints decreased the females became likewise more degenerated or differentiated from the typical form; hence these two characters are the basis of the superfamilies. The specialization of characters is also paralleled in the reduction of the number of veins in the wings. Biologically the difficulty of gaining access to new hosts becomes greater in the progression of the superfamilies.

3. The subfamily when used designates a difference in the character of mouth parts. The character of the number of median genital tubes in the female is also of subfamily value.

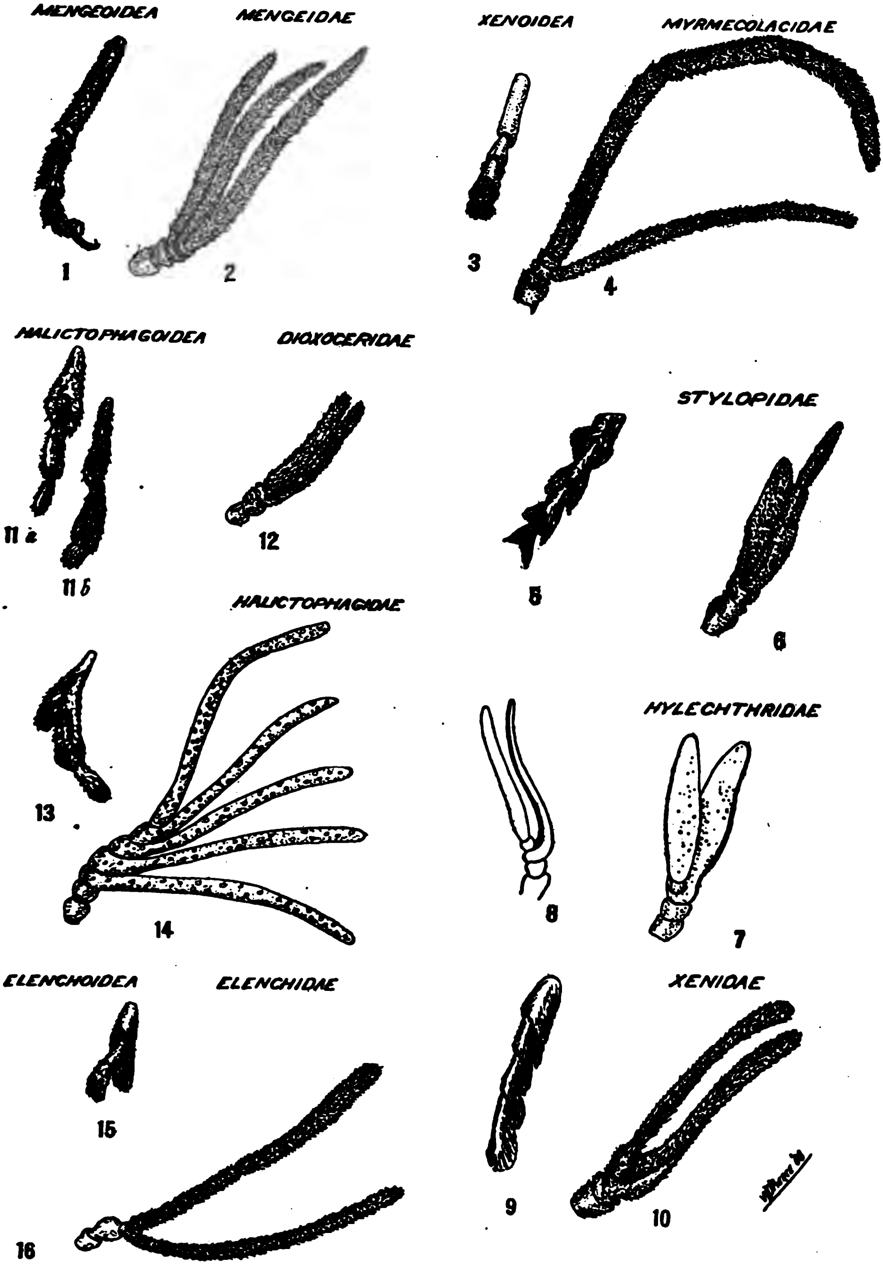

Fig. 3.—Diagram of tarsi and antennae, showing family characters. 1-2, Trioxocera mexicana; 3-4, Caenocholax fenyesi; 5-6, Stylops crawfordi; 7-8, Hylecthrus rubi; 9-10, Acroschismus pallidus; 11-12, Dioxocera insularum; 13-14, Anthericomma barberi; 15-16, Mecynocera koebelei.

4. The tribe is a division of convenience at present, separating genera confined to a single family of hosts.

5. The genera are based on the characters of the mouth parts, genitalia, wing venation, and thoracic structure. They are found to be confined to single genera of hosts.

6. The species are based on proportionate lengths of mouth parts, width of head, wing venation, the shape of the œdeagus, position of genital pore and coloration in the male; and on the shape of the cephalothorax and mandibles in the female. They are as a rule confined to single species of hosts.

MALES.

Table of superfamilies and families based on males.

Winged, elytrophorous.
  Tarsi with five joints and two tarsal claws.....Superfamily MENGEOIDEA Pierce.
  Tarsi with four joints; antennæ with third joint laterally produced. Superfamily XENOIDEA Pierce.
  Tarsi with three joints..................Superfamily HALICTOPHAGOIDEA Pierce.
  Tarsi with two joints.........................Superfamily ELENCHOIDEA Pierce.

Superfamily MENGEOIDEA Pierce.

Antennæ seven-jointed, third and fourth joints laterally produced. I. MENGEIDÆ Pierce.

Superfamily XENOIDEA Pierce.

Antennæ seven-jointed, fourth joint short, others beyond elongate. II. MYRMECOLACIDÆ Pierce.
Antennæ six-jointed, the last three joints not much surpassing the flabellum of the third .... III. STYLOPIDÆ Kirby.
Antennæ five-jointed, with fourth joint very short, and fifth elongate. IV. HYLECHTHRIDÆ Pierce.
Antennæ four-jointed, with flabellum of third, and fourth joint elongate, subequal. V. XENIDÆ Semenov.

Superfamily HALICTOPHAGOIDEA Pierce.

Antennæ seven-jointed, with the third, fourth, fifth, and sixth joints laterally produced, and the seventh elongate .... VI. HALICTOPHAGIDÆ Pierce.
Antennæ four-jointed, with the flabellum of the third, and fourth joint elongate, subequal .... VII. DIOXOCERIDÆ Pierce.

Superfamily ELENCHOIDEA Pierce.

Antennæ five-jointed, with the third laterally produced, and the fourth and fifth elongate .... VIII. ELENCHIDÆ Pierce.

Table of genera.

1. Family MENGEIDÆ Pierce.

Mandibles, maxillæ and maxillary palpi present, labial palpi absent; wings having eight primary veins from base, with one distal unattached vein between subcosta and radius and with the first and second anal apically united.... 1. *Mengea* Grote.
Mandibles apparently absent; wings with seven primary veins from base, with one distal detached vein beyond the tip of the radius, another above the radius, medius with two superior branches; third anal lacking......... 2. *Trioxocera*, new genus.

2. Family Myrmecolacidæ Pierce.

Wings with all eight primary veins from base, the medius curved upward and branched at right angles.................................... 3. *Myrmecolax* Westwood.

Wings having only six primary veins, the cubitus and third anal being missing, with a short detached vein just below the apex of the radius, medius short and continued by a long detached vein beginning behind it and shortly before its apex.
4. *Cænocholax*, new genus.

3. Family Stylopidæ Kirby.

Wings with eight primary veins from base, with two distal detached veins between the radius and medius; antennæ short and robust.............. 5. *Stylops* Kirby.

Wings with seven primary veins from base, cubitus missing, costal margin with distinct stigma, subcosta and radius apically united, a detached branch of radius immediately posterior to that vein, a detached branch of medius between radius and medius; third anal very short; antennæ more attenuate. 6. *Parastylops* Meijere.

Males unknown.................................... 7. *Halictostylops* new genus.

4. Family Hylechthridæ Pierce.

Wings with seven primary veins from base, with two distal detached veins between the radius and medius, which are basally united, and with the cubitus appearing as a detached vein... 8. *Hylechthrus* Saunders.

5. Family Xenidæ Semenov.

Maxillæ simple, two-jointed.
  Scutellum of metathorax pedunculate anteriorly, postlumbium short and transverse; œdeagus inflated at basal angle...................... *Xeninæ* Pierce.
  Scutellum of metathorax not pedunculate anteriorly; postlumbium more than half as long as wide; œdeagus not conspicuously inflated at basal angle.
Halictoxeninæ Pierce.

Maxillæ three-jointed, apparently.
  Scutellum of metathorax pedunculate anteriorly; postlumbium short and transverse (if Westwood saw the mouth parts wrongly this group must become a part of the Xeninæ).. *Homilopinæ* Pierce.
  Scutellum of metathorax not pedunculate anteriorly; postlumbium more than half as long as wide; œdeagus beginning as a narrow tube, then greatly inflated, bent at right angles and produced as a very slender process; (in previous publications the writer interpreted the mouth parts incorrectly to include a third pair)... *Crawfordinæ* Pierce.

Subfamily Xeninæ Pierce.

Wings having eight primary veins.
  Wings with two distal detached veins between the radius and medius, and one detached vein between the medius and cubitus; postlumbium very short, transverse and not differing in consistency from the scutellum or postscutellum.
19. *Eupathocera* Pierce.
  Wings with two distal detached veins between the radius and medius.
    Antennæ foliaceous, bluntly rounded at tips of ramæ (œdeagus not bounded at base by two apical lobes, simple, sinuate, reflexed).
      Palpi with basal joint short, robust, second elongate, subcylindrical, deflexed; œdeagus longitudinally ridged...... 13. *Pseudoxenos* Saunders.
      Palpi with basal joint crassate, arcuate, second cylindrical, deflexed.
16. *Paraxenos* Saunders.
    Antennæ tapering to tips of ramæ, short, hardly longer than head is wide, ramæ equal, deflexed, compressed somewhat ensiform; œdeagus arising between two reflexed lobes, broad at base, strongly reflexed toward apex, apically acute .... 9. *Xenos* Rossi.

Wings having seven primary veins, third anal missing.
  Wings with one distal detached vein between radius and medius, and one between medius and cubitus; œdeagus considerably dilated at base, arising between two reflexed lobes.................................. 10. *Acroschismus* Pierce.
    Œdeagus cleft at apex .... 11. *Schistosiphon* Pierce.
  Wings with two distal detached veins between radius and medius, and one between medius and cubitus..................... 18. *Ophthalmochlus* Pierce.

Males unknown ....
- 12. *Vespæxenos*, new genus.
- 14. *Leionotoxenos*, new genus.
- 17. *Sceliphronechthrus*, new genus.
- 15. *Monobiaphila*, new genus.

Subfamily Homilopinæ Pierce.

Genitalia consisting merely of a two-jointed plate-like exserted appendage (ninth and tenth segments), œdeagus not visible (according to Templeton).
20. *Homilops* Pierce.

Subfamily Crawfordinæ Pierce.

Œdeagus not reflexed, nor bounded at base by lobes, very narrow at base, vesiculate and bent at middle, tenuate and very acute at apex; wings having six primary veins from base, second anal appearing as a branch of the first anal. 23. *Crawfordia* Pierce.

Subfamily Halictoxeninæ Pierce.

Maxillæ with first joint longer than the second; œdeagus strongly arcuate beneath at middle.. 21. *Halictoxenos* Pierce.
Maxillæ with first joint shorter than the second; œdeagus not strongly arcuate beneath at middle; wings with two detached branches of radius, and two of medius between the radius and medius................ 22. *Apractelytra* Pierce.

6. Family Halictophagidæ Pierce.

Prothorax band-like, not interrupted.
  Prothorax simple, not arched forward; wings having seven primary veins from base, with two distal detached veins between the radius and medius, cubitus lacking.
    Medius simple.................................. 25. *Pentacladocera* Pierce.
    Medius broken, or with detached vein commencing just before the apex on its anal side .... 24. *Halictophagus* Dale.
  Prothorax and mesothorax arched forward, fitting into excavation of head; wings having seven primary veins from base, the radius meeting the costal margin, a detached branch of medius immediately below that vein, medius with a branch in front and one behind, both as a rule detached but arising close to the medius.
    Œdeagus large at base, acute and greatly reflexed at apex; antennæ with the third joint very short and flat; maxillæ with first joint very slender and over half as long as the second.................... 26. *Pentoxocera* Pierce.
    Œdeagus more slender, but with reflexed apex proportionately shorter and less acute than in preceding genus; antennæ with the third joint cylindrical and as long as the preceding; maxillæ with first joint very short and stout, and only about one-third as long as the second; radius and medius basally united for a short distance............. 29. *Neocholax*, new genus.
Prothorax represented by a pronotal and prosternal disc placed in the excavation of the head and mesonotum; wings having six primary veins from base, with one distal detached vein between the radius and medius and with the medius branched above and below, the branches slightly separated from the main vein, cubitus and third anal veins lacking.. 30. *Anthericomma* Pierce.

Males unknown..
- 27. *Agalliaphagus* Pierce.
- 28. *Megalechthrus* Perkins.

7. Family Dioxoceridæ Pierce.

Thorax normal.. 31. *Dioxocera* Pierce.

8. Family Elenchidæ Pierce.

Mouth parts consisting of mandibles and two-jointed maxillæ.
  Species large; first antennal joint elongate, second very short and transverse; frontal process not prominent; oral cavity broad, semicircular. 36. *Deinelenchus* Perkins.
  Species small; first two antennal joints subequal; frontal process prominent; oral cavity triangular; wings having five primary veins from base, with one distal detached vein between the radius and medius, and two brief basal veins representing the cubitus and first anal...................... 32. *Elenchus* Curtis.
Mouth parts consisting of mandibles and two-jointed maxillæ, bearing on the first joint an elongate, knobbed, linear, chitinous filament; species small; oral cavity triangular; wings as in the preceding, but without traces at base of cubitus and first anal.. 34. *Mecynocera* Pierce.

Males unknown................................
  37. *Colacina* Westwood.
  33. *Elenchoides*, new genus.
  35. *Pentagrammaphila*, new genus.

Artificial key to genera based on wing venation.

1. Eight primary veins from base (costa, subcosta, radius, medius, cubitus, three anal). (The costa is always a very short, inconspicuous vein at the base and is merged with the subcosta).
   a. One distal detached vein between the subcosta and radius; first and second anal veins apically united.................................. *Mengea* Grote.
   b. Two detached branches of radius and two of medius between radius and medius.. *Apractelytra* Pierce.
   c. One detached branch of radius and one of medius between radius and medius..........................
     Xenos Rossi.
     Pseudoxenos Saunders.
     Paraxenos Saunders.
     Stylops Kirby.
   d. One detached branch of radius and one of medius between radius and medius; and detached branch of medius between medius and cubitus. *Eupathocera* Pierce.
   e. Medius curved upward and branched toward apex..... *Myrmecolax* Westwood.
2. Seven primary veins from base.
   a. Cubitus appearing as a detached vein; radius and medius basally united: with a detached branch of each between them............... *Hylechthrus* Saunders.
   b. Third anal lacking.
     A detached branch of radius and one of medius between radius and medius; a detached branch of medius between medius and cubitus. *Ophthalmochlus* Pierce.
     Radius sometimes broken for a short distance; a detached branch of medius between radius and medius; a detached branch of medius immediately behind medius..................................
       Acroschismus Pierce.
       Schistosiphon Pierce.
     Radius broken for a considerable distance; medius with one detached and two connected branches in front of it.................... *Trioxocera* Pierce.
   c. Cubitus lacking.
     Two detached branches of medius between radius and medius.
       Medius branched near apex behind.............. *Pentoxocera* Pierce.
       Medius with detached vein commencing just before the apex on its anal side..................................... *Halictophagus* Dale.
     Two detached branches of medius between radius and medius. *Pentacladocera* Pierce.

3. Six primary veins from base.
   - *a.* Cubitus and third anal lacking.
     - Detached branch of radius between radius and medius; also detached branch of medius behind medius.......................... *Caenocholar* Pierce.
     - Detached branch of radius, and one of medius between radius and medius; also branch of medius behind medius............ *Anthericomma* Pierce.
   - *b.* Only one anal vein arising from base; second anal appearing as a detached branch of first anal.................................... *Crawfordia* Pierce.
4. Five primary veins from base (costa, subcosta, radius, medius, anal).
   - *a.* One detached branch of medius between radius and medius; cubitus and first anal indicated at base................................... *Elenchus* Curtis.
   - *b.* One detached branch of medius between radius and medius.. *Mecynocera* Pierce.

(Owing to the necessity of forming part of this table from published drawings there is a possibility that the venation has not in every case been interpreted correctly. The venation should not be used for identification unless the other available characters are obscured.)

FEMALES.

Table of superfamilies, families, and genera based on females.

1. Spiracles more or less easily discernible, generally prominent; four or five genital tubes entering brood canal...................Superfamily XENOIDEA Pierce.
   Spiracles not usually discernible, never prominent............................2.
2. Tubercles of head apical.................Superfamily HALICTOPHAGOIDEA Pierce.
   Tubercles of head more or less obsolete, ventral; only three genital tubes entering brood canal.................................Superfamily ELENCHOIDEA Pierce.

Superfamily XENOIDEA Pierce.

1. Head considerably narrower than metathorax at spiracles.......................2.
   Head not considerably narrower than metathorax at spiracles...................5.
2. HYLECHTHRIDÆ: Head not more than one-half as wide as metathorax at spiracles; lateral lobes of mesothorax indicating presence of supposed mesothoracic spiracles (according to Saunders); lower lip (ventral) overhanging transverse slit; mandibles merely lobes... *Hylechthrus* Saunders.
   Head often much less than one half as wide as metathorax; no lateral lobes indicating presence of suppressed mesothoracic spiracles.........................3.
3. Head about one-third width of metathorax at spiracles........................4.
   STYLOPIDÆ: Cephalothorax broadly truncate or rounded at apex; head about one-half width of metathorax at spiracles; five genital tubes entering brood canal... *Stylops* Kirby.
   XENIDÆ. Cephalothorax almost triangular, lateral margins sinuate; five genital tubes entering brood canal................................ *Halictoxenos* Pierce.
4. STYLOPIDÆ (?): Cephalothorax almost triangular, narrowly truncate at apex. *Halictostylops* Pierce.
5. Cephalothorax with lateral lines extending from mandibles to spiracles. *Crawfordia* Pierce.
   Cephalothorax with head extending laterally not more than two-thirds of the distance to the spiracles; four genital tubes entering brood canal. *Xeninx*, *Homilopinx*.

Superfamily HALICTOPHAGOIDEA Pierce.

1. Transverse slit narrow .... **2.**
Head subtruncate at apex, transverse slit very broad, cutting a deep three-sided emargination in the head .... *Agalliaphagus* Pierce.
2. Mandibles prominent, toothed; thorax shorter than head, ventral slit turned posteriorly at sides .... *Dioxocera* Pierce.
Mandibles mere lobes .... **3.**
3. Thorax shorter than head, rather suddenly narrowed to base; sides of head oblique. *Pentoxocera* Pierce.
Thorax longer than head, gradually narrowed to base; side of head convex. *Megalechthrus* Perkins.

Superfamily ELENCHOIDEA Pierce.

1. Head trilobed, mouth seemingly on an elevation; transverse slit narrow. *Deinelenchus* Perkins.
Head presenting two obsolete areas; transverse slit very broad, deeply cutting a rounded emargination into thorax; a thin curtain overhanging cavity at base. *Mecynocera* Pierce.

An interesting and valuable comparison of genera may be had by giving the range of variation in the following ratios. The first ratio is that of the breadth at the spiracles (5) to the distance between the mandibles (3); the second is that of the breadth of the head (4) to the distance between the mandibles (3); the third is that of the breadth at the spiracles (5) to the breadth of the head (4); the fourth is that of the breadth of the spiracles (5) to the distance from spiracles to apex (2).

Genus.	Cephalothorax. to mandibles. (5):(3)::—:1.	Head to mandibles. (4):(3)::—:1.	Cephalothorax to head. (5):(4)::—:1.	Breadth to length. (5):(2)::—:1.
Dioxocera	3.15	3.15	1.00	1.40
Crawfordia	3.14–4.63	2.96–4.47	1.03–1.06	1.41–1.76
Vespaexenos	4.12	3.50	1.17	1.04
Leionotoxenos	4.66–5.11	4.00–4.90	1.03–1.16	1.33–1.64
Acroschismus	4.42–5.90	3.36–4.68	1.22–1.46	1.31–2.43(?)
Sceliphronechthrus	5.54	4.18	1.32	1.84
Stylops	6.06–8.11	3.46–5.64	1.36–1.88	1.32–1.77
Homilops	6.26–8.30	5.12–6.00	1.14–1.41	1.74–1.95
Monobiaphila	6.93	4.40	1.60	1.76
Halictoxenos typical	6.66–9.71	3.16–5.00	1.90–2.10	1.29–1.55
s. g. ***Halictophilus***	7.81–8.00	5.45–5.70	1.40–1.43	1.32–1.33

Table for separation of genera of the Triungulinids.

1. Nine abdominal segments simple, the tenth consisting of two large lateral lobes, each bearing a long stylet .... *Stylops, Halictoxenos.*
Eight abdominal segments simple, ninth elongate inclosing tenth .... **2.**
2. Ninth laterally armed with stylets, and tenth apically so .... *Mecynocera.*
Tenth only, terminated by two large approximate lobes bearing stylets. *Acroschismus, Vespaexenos, Monobiaphila, Leionotoxenos, Ophthalmochlus, Homilops,* **and** *Pentoxocera.*

The following arrangement will illustrate the progression of specialization in five of the principal characters in the order:

Name.	Males.			Females.	Triungulinids.
	Number of tarsal joints.	Number of antennal joints.	Number of primary veins in wings.	Number of genital tubes.	Number of simple segments in abdomen.
	Mengeoidea.	*Mengeidæ.*			
Mengea	5	7	8	(?)	(?)
Trioxocera	5	7	7	(?)	(?)
	Xenoidea.	*Myrmecolacidæ.*			
Myrmecolax	4	7	8	(?)	(?)
Caenocholax	4	7	6	(?)	(?)
		Stylopidæ.			
Stylops	4	6	8	5	9
		Hylechthridæ.			
Hylechthrus	4	5	7	(?)	(?)
		Xenidæ		*Halictoxeninæ.*	
Halictoxenos	4	4	(?)	5	9
				Xeninæ.	
Xenos	4	4	8	4	8
Apractelytra *Pseudoxenos*	4	4	8	(?)	(?)
Monobiaphila *Leionotoxenos*	4	4	(?)	(?)	8
Paraxenos *Eupathocera*	4	4	8	(?)	(?)
Ophthalmochlus	4	4	7	(?)	8
Schistosiphon	4	4	7	(?)	(?)
Acroschismus	4	4	7	4	8
Homilops	4	4	(?)	(?)	8
			Crawfordinæ.		
Crawfordia	4	4	5	(?)	(?)
	Halictophagoidea.	*Dioxoceridæ.*			
Dioxocera	3	4	(?)	(?)	(?)
		Halictophagidæ.			
Halictophagus	3	7	6	(?)	(?)
Pentoxocera	3	7	6	(?)	8
Anthericomma	3	7	5	(?)	(?)
	Elenchoidea.	*Elenchidæ.*			
Mecynocera	2	5	4	(?)	8
Elenchus	2	5	(?)	(?)	(?)
Elenchoides	(?)	(?)	(?)	3	(?)

The two points which stand out in this comparison are the affinities of *Halictoxenos* to the Stylopidæ as well as Xenidæ, and the intermediate position of *Dioxocera* between the Xenidæ and Halictophagidæ. The grouping of genera in the Xenidæ is very weak at present, owing to the deficiencies in our knowledge, hence the best possible way of grouping the genera at present is by host relationships. Many surprises are still in store in this order, and the classification will undoubtedly need many revisions. The group Homilopinæ rests upon a description which may prove wrong; in such event *Homilops* will group with the Ophthalmochlini. If the genitalia of *Schistosiphon peckii* should prove to have been incorrectly figured and described, and to be of the same character as those of *Acroschismus*, then *Schistosiphon* must become a synonym. If *Halictostylops spencii* is bred and proven to be xenid, as the writer expects will happen, the genus *Halictostylops* may become a synonym of *Halictoxenos* which is first described in the tables of genera. The classification of the Halictophagoidea and Elenchoidea is hardly more than suggested. These superfamilies will prove very fertile in their diversity of forms.

CORRELATION OF HOST AND PARASITE CLASSIFICATIONS.

	Mengeoidea.
	Mengeidæ.
Unknown fossil host.	Mengea; Germany.
Hymenoptera.	Xenoidea.
Formicoidea.	Myrmecolacidæ.
Formicidæ.	Myrmecolax; Ceylon.
Apoidea.	
Prosopidæ.	Hylechthridæ.
Prosopis.	Hylechthrus; Europe.
Andrenidæ.	Stylopidæ.
Andrena.	Stylops; America, Europe.
Halictus.	(?) Halictostylops; Europe.
	Xenidæ.
	Halictoxeninæ.
Halictus.	Halictoxenos; America.
Panurgidæ.	Crawfordinæ.
Panurginus.	Crawfordia; America.
Vespoidea.	Xeninæ.
Vespidæ.	Xenini.
Polistes.	Xenos; Europe, America (?).
Polistes.	Acroschismus; America.
Polistes.	Schistosiphon; America.
Vespa.	Vespæxenos; Asia.
Eumenidæ.	Pseudoxenini.
Odynerus.	Pseudoxenos; Europe.
Leionotus.	Leionotoxenos; America.
Monobia.	Monobiaphila; America.
Bembecidæ.	Paraxenini.
Bembecinus.	Paraxenos; Europe.
Sphecoidea.	
Sphecidæ.	Ophthalmochlini.
Sceliphron.	Sceliphronechthrus; America.
Prionomyx.	Ophthalmochlus; America.
Sphex (Ammophila).	Eupathocera; America.
	Homilopinæ.
Proterosphex.	Homilops; America, Asia (?).

Homoptera.	Halictophagoidea.
Cicadoidea.	
Tetigoniidæ.	
Penthimiini.	Dioxoceridæ.
Xerophloea.	Dioxocera; America.
	Halictophagidæ.
Tetigoninii.	
Tetigonia.	Pentoxocera; Australia.
Eurymelini.	
Agallia.	Agalliaphagus; America.
(?) Agallia.	Pentacladocera; Australia.
Genus unknown.	Halictophagus; Europe.
Genus unknown.	Anthericomma; America.
Fulgoroidea.	
Issidæ.	Neocholax; Java.
Eurybrachyinæ.	
Platybrachys.	Megalechthrus; Australia.
	Elenchoidea.
	Elenchidæ.
(?) Platybrachys.	Deinelenchus; Australia.
Asiracidæ.	
Perkinsiella.	Elenchoides; Oceana.
Liburnia.	Elenchus; Europe.
Liburnia.	Mecynocera; America.
Pentagramma.	Pentagrammaphila; America.
Poekillopteridæ.	
Tropiduchinæ.	
Tropiduchini.	
Epora.	Colacina; Malaysia.

CHECK LIST OF THE STREPSIPTERA OF THE WORLD.

I. Superfamily MENGEOIDEA Pierce, 1908.

1. Family Mengeidæ Pierce, 1908.

1. Genus *Mengea* Grote, 1886 (*Trixna* Menge, 1866).
    1. *tertiaria* Menge, 1866 (type); fossil.
2. Genus *Trioxocera* Pierce.
    1. *mexicana* Pierce (type); Mexico.

II. Superfamily XENOIDEA Pierce, 1908.

2. Family Myrmecolacidæ Pierce, 1908.

3. Genus *Myrmecolax* Westwood, 1858.
    1. *nietneri* Westwood, 1858 (type); Ceylon.
4. Genus *Cænocholax* Pierce.
    1. *fenyesi* Pierce (type); Mexico.

3. Family STYLOPIDÆ Kirby, 1813.

5. Genus *Stylops* Kirby, 1802.
    1. *melittæ* Kirby, 1802 (type); Europe.
       (*haworthi* Stephens, 1829.)
       (*kirbii* Leach, 1814.)
    2. *dalii* Curtis, 1828; England.
       (*dahlii* Friese, 1906.)
    3. *childreni* Gray, 1832; Nova Scotia.
    4. *spencii* Pickering, 1835; Europe.
    5. *aterrima* Newport, 1847; England.
       (*trimmerana* Smith, 1857.)
    6. *thwaitei* Saunders, 1872; Europe.
    7. *advarians* Pierce; British Columbia.
    8. *bipunctatæ* Pierce; United States.
    9. *bruneri* Pierce; United States.
    10. *californica* Pierce; California.
    11. *claytoniæ* Pierce; United States.
    12. *cornii* Pierce; Wisconsin.
    13. *crawfordi* Pierce; Texas.
    14. *cressoni* Pierce; Maine.
    15. *dominiquei* Pierce; France.
    16. *grænicheri* Pierce; Wisconsin.
    17. *hartfordensis* Pierce; Georgia.
    18. *hippotes* Pierce; Ohio.
    19. *imitatrix* Pierce; Texas.
    20. *multiplicatæ* Pierce; Wisconsin.
    21. *nasoni* Pierce; Pennsylvania.
    22. *nassonowi* Pierce; Europe.
    23. *nubeculæ* Pierce; Colorado.
    24. *packardi* Pierce; Massachusetts.
    25. *polemonii* Pierce; Colorado.
    26. *saliciflorís* Pierce; Washington.
    27. *solidulæ* Pierce; Washington.
    28. *sparsipilosæ* Pierce; Maine.
    29. *subcandidæ* Pierce; Southern California.
    30. *swenki* Pierce; United States.
    31. *ventricosæ* Pierce; Europe.
    32. *vicinæ* Pierce; United States.
    33. *vierecki* Pierce; Texas.
    34. *oklahomæ* Pierce; Oklahoma.
6. Genus *Parastylops* Meijere, 1908.
    1. *flagellatus* Meijere, 1908 (type); Java.
7. Genus *Halictostylops* Pierce.
    1. *spencii* Nassonow, 1893 (type); Europe.

4. Family HYLECHTHRIDÆ Pierce, 1908.

8. Genus *Hylechthrus* Saunders, 1850.
    1. *rubi* Saunders, 1850 (type); Epirus.
       var. *pustulatus* Saunders, 1872.
    2. *quercus* Saunders, 1850; Epirus.
    3. *sieboldii* Saunders, 1852; Epirus.

5. Family XENIDÆ Semenov, 1902.

1. Subfamily XENINÆ Pierce, 1908.

1. Tribe XENINI Pierce.

9. Genus *Xenos* Rossi, 1790.
    1. *vesparum* Rossi, 1790 (type); Europe.
    2. *jurinei* Saunders, 1872; Europe.
10. Genus *Acroschismus* Pierce, 1908.
    1. *hubbardi* Pierce (type), 1908; Florida.
    2. *bruesi* Pierce; Michigan.
    3. *nigrescens* Brues, 1903; Texas.
    4. *pallidus* Brues, 1903; United States.
        var. *texensis* Pierce; Texas.
    5. *pecosensis* Pierce; Texas.
    6. *wheeleri* Pierce; Connecticut, District of Columbia.
        (*peckii* Brues, 1903.)
    7. *bowditchi* Pierce; United States.
    8. *hunteri* Pierce; Texas.
    9. *texani* Pierce; Texas.
    10. *rubiginosi* Pierce; Louisiana.
    11. *maximus* Pierce; Texas.
11. Genus *Schistosiphon* Pierce, 1908.
    1. *peckii* Kirby, 1813 (type); Massachusetts.
12. Genus *Vespæxenos* Pierce.
    1. *crabronis* Pierce (type); Japan.
    2. *moutoni* Buysson, 1903; China.
    3. *buyssoni* Pierce; Annam.

2. Tribe PSEUDOXENINI Pierce.

13. Genus *Pseudoxenos* Saunders, 1872.
    1. *schaumii* Saunders, 1872 (type); Corcyra.
    2. *klugii* Saunders, 1852; Epirus.
    3. *corcyricus* Saunders, 1872; Corcyra.
    4. *heydenii* Saunders, 1852; Epirus, Corcyra.
14. Genus *Leionotoxenos* Pierce.
    1. *jonesi* Pierce; Louisiana.
    2. *louisianæ* Pierce; Louisiana.
    3. *hookeri* Pierce; Texas.
15. Genus *Monobiaphila* Pierce.
    1. *bishoppi* Pierce (type); Texas.

3. Tribe PARAXENINI Pierce.

16. Genus *Paraxenos* Saunders, 1872.
    1. *erberi* Saunders, 1872 (type); Corcyra.

4. Tribe OPHTHALMOCHLINI Pierce.

17. Genus *Sceliphronechthrus* Pierce.
    1. *fasciati* Pierce (type); Santo Domingo.
18. Genus *Ophthalmochlus* Pierce, 1908.
    1. *duryi* Pierce, 1908 (type); Ohio.
19. Genus *Eupathocera* Pierce, 1908.
    1. *lugubris* Pierce, 1908 (type); Ohio.
    2. *pruinosæ* Pierce; Colorado.
    3. *sphecidarum* Dufour, 1837; Europe.
    (?) 4. *sieboldii* Saunders, 1872; Germany.

2. Subfamily HOMILOPINÆ Pierce, 1908.

20. Genus *Homilops* Pierce, 1908.
    1. *westwoodii* Templeton, 1838 (type); Brazil.
    2. *bishoppi* Pierce; Texas.
    3. *ashmeadi* Pierce; Santo Domingo.
    4. *abbotti* Pierce; Siam.

3. Subfamily HALICTOXENINÆ Pierce, 1908.

21. Genus *Halictoxenos* Pierce, 1908.
  Subgenus *Halictoxenos* Pierce.
    1. *jonesi* Pierce, 1908 (type); Louisiana.
    2. *crawfordi* Pierce; Nebraska.
    3. *grænicheri* Pierce; Wisconsin.
    4. *versati* Pierce; Wisconsin.
    5. *zephyri* Pierce; Wisconsin.
    6. *sparsi* Pierce; Oklahoma.
  Subgenus *Halictophilus* Pierce.
    7. *manilæ* Pierce; Philippines.
    8. *robbii* Pierce; Philippines.
22. Genus *Apractelytra* Pierce, 1908.
    1. *schwarzi* Pierce, 1908 (type); District of Columbia.

4. Subfamily CRAWFORDINÆ Pierce, 1908.

23. Genus *Crawfordia* Pierce, 1908.
    1. *pulvinipes* Pierce, 1904 (type); Nebraska.
    2. *cockerelli* Pierce; New Mexico.

III. Superfamily HALICTOPHAGOIDEA Pierce, 1908.

6. Family HALICTOPHAGIDÆ Pierce, 1908.

24. Genus *Halictophagus* Dale, 1832.
    1. *curtisii* Dale, 1832 (type); England.
25. Genus *Pentacladocera* Pierce, 1908.
    1. *schwarzii* Perkins, 1905 (type); New South Wales.
26. Genus *Pentoxocera* Pierce, 1908 (*Bruesia* Perkins, 1905).
    1. *australensis* Perkins, 1905 (type); Queensland.
    (?) 2. *phæodes* Perkins, 1905; Queensland.
    (?) 3. *stenodes* Perkins, 1905; Queensland.
    (?) 4. *schwarzi* Pierce; Guatemala.
27. Genus *Agalliaphagus* Pierce, 1908.
    1. *americanus* Perkins, 1905 (type); Ohio.
28. Genus *Megalechthrus* Perkins, 1905.
    1. *tryoni* Perkins, 1905 (type); Queensland.
29. Genus *Neocholax* Pierce.
    1. *jacobsoni* Meijere, 1908 (type); Java.
30. Genus *Anthericomma* Pierce, 1908.
    1. *barberi* Pierce, 1908 (type); New Mexico.

7. Family DIOXOCERIDÆ Pierce, 1908.

31. Genus *Dioxocera* Pierce, 1908.
    1. *insularum* Pierce (type); West Indies.

IV. Superfamily ELENCHOIDEA Pierce, 1908.

8. Family Elenchidæ Pierce, 1908.

32. Genus *Elenchus* Curtis, 1831.
    1. *walkeri* Curtis, 1829 (type); Great Britain.
    2. *tenuicornis* Kirby, 1815; England.
    3. *templetonii* Westwood, 1835; Mauritius.
33. Genus *Elenchoides* Pierce.
    1. *perkinsi* Pierce (type); Fiji.
34. Genus *Mecynocera* Pierce, 1908.
    1. *kœbelei* Pierce, 1908 (type); Ohio.
35. Genus *Pentagrammaphila* Pierce.
    1. *uhleri* Pierce (type); Dacota.
36. Genus *Deinelenchus* Perkins, 1905.
    1. *australensis* Perkins, 1905 (type); Queensland.
37. Genus *Colacina* Westwood, 1877.
    1. *insidiator* Westwood, 1877 (type); Borneo.

DESCRIPTIONS OF STREPSIPTERA.

STREPSIPTERA KIRBY REDESCRIBED.

Kirby, 1813; Klug, 1814; Germar, 1817; MacLeay, 1821; Hoeven, 1828; Stephens, 1829; Pickering, 1835; Westwood, 1835; Templeton, 1838; Westwood, 1840; Siebold, 1843; Newport, 1845, 1847; Hoeven, 1850; Saunders, 1850; Newport, 1851; Siebold, 1853; Saunders, 1853; Joly, 1858; Westwood, 1861; Schaum, 1864; Mäklin, 1867; Blanchard, 1868; Kraatz, 1870; Siebold, 1870; Müller, 1872; Riley, 1873; Westwood, 1877; Carus, 1879–1899; Brandt, 1879, 1882; Friese, 1883; Harris, 1884; Kolbe, 1884–86; Müller, 1887; Claus, 1888; Mayer, 1888–1894; Nassonow, 1892, 1893; Meinert, 1896; Janet, 1897; Nassonow, 1897; Sharp, 1899, 1900–1905; Buysson, 1903; Holmgren, 1903; Handlirsch, 1903, 1904; Boerner, 1904; Clark, 1904; Henneguy, 1904; Klapalek, 1904; Shipley, 1904; Pierce, 1908.

Name derived from στρέφειν (στρέψαι) to twist, +πτερόν, a wing=twisted wings.

SYNONYMY.

Xenos, 1749 (a genus next to Ichneumon), Rossi, 1790, 1793.

Phthiromyæ, 1807 (Tribe III, Diptera), Latreille, 1807.

Stylopidæ, 1813 (a family in Coleoptera, Heteromera); Stephens, 1829; Westwood, 1839; Schaum, 1862; Crotch, 1863; Dallas, 1867, 1868; Packard, 1870, 1872; Sharp, 1871; Saunders, 1871; Rye, 1871–1879; Ebell, 1872; Saunders, 1877; Austin, 1882; LeConte and Horn, 1883; W. F. Kirby, 1883-84; Henshaw, 1885; J. B. Smith, 1885; Scudder, 1885, 1886; Sharp, 1887–1894; Scudder, 1890; J. B. Smith, 1890; Schwarz, 1891; Dale, 1892; Comstock, 1895; J. B. Smith, 1899; Dury, 1902; Green, 1902; Brues, 1903; Pierce, 1904; Brues, 1905; Perkins, 1905; Friese, 1906; Dury, 1906. (Kirby, 1813, used "Stylopidae" as the base family of Strepsiptera.)

Rhipidoptera, 1816 (a family in Diptera), Lamarck, 1816, 1835; Menge, 1866.

Rhipiptera, 1817 (an order), Latreille, 1817; Guérin-Meneville, 1829–1838; Latreille, 1836; Erichson, 1841; Latrielle, 1845; Duval, 1857; Laboulbene, 1876; Acloque, 1897.

Rhiphiptera, 1817 (a mistake for Rhipiptera), Leach, 1817, 1819.

Strepsiptera, 1827 (a family, Neuroptera Trichoptera), Gegenbaur, 1827.

Stylopidæ, 1840 (a family, Neuroptera, between Forficulidæ and Phryganeidæ), Shuckard, 1840.

Stylopites, 1847 (a tribe, Coleoptera), Newman, 1845, 1847, 1850; Smith, 1850; Schaum, 1852.

Stylopides, 1859 (a family, Coleoptera), Lacordaire, 1859.

Strepsiptera, 1883 (a family, Coleoptera, Heteromera), SHARP, 1881; KARSCH, 1883; SHARP, 1895–1898; SEIDLITZ, 1903–1905.

Strepsiptera, 1885 (a family, Coleoptera, Malacodermata), BRAUER, 1885.

Stylopinæ, 1900 (a subfamily, Coleoptera, Melandryidæ), LAMEERE, 1900.

Xenidæ, 1902 (a family, Coleoptera, Tenebrionoidea, near Rhipidophoridæ), SEMENOV, 1902; JACOBSON, 1904.

CHARACTERIZATION.

An order of hypermetamorphic endoparasitic insects with highly specialized reduction of certain functional organs, great specialization of other functional organs, and with dissimilar sexes.

Male.—Elytrophorous, winged, ephemeral, aerial. Head and thoracic segments united by elastic commissures. Head transverse, with eyes stalked and composed of regularly placed separated hexagonal ommatidia. Mouthparts specialized, rudimentary, vestigial, or lacking. Labrum and labium absent; pharynx presenting a great exposed surface which is folded crater-like and contracts into a small tube distant from the appendages; mandibles and maxillæ arising beneath the genæ near their base; maxillæ more or less reduced. Antennæ sensitive, with one or more joints laterally produced.

Thorax with principal parts capable of independent movement. Prothorax much reduced; mesothorax reduced; metathorax greatly elongated, occupying at least one-half the length of the body and apically covering the base of the abdomen. Front coxal cavities open behind; tarsi with each joint pulvilliform below (except in Mengeidæ and Myrmecolacidæ); tarsal claws present in only the Mengeidæ. The legs are unfit for use except in adhering to the body of the female's host during copulation, which is the only function of the males. Halteres, or balancers, attached very low on the mesopleuræ and not serving as a protection to the wings, deformed and greatly reduced. The mesostigmata are frequently protected by a lobe-like process beneath the base of each elytron. Wings folded longitudinally; veining simple, radial. Genitalia with œdeagus exposed, arising at tip of ninth segment; ninth segment ventrally much surpassing tenth, at the tip of which is the anus.

Female.—Larviform, apodous, permanently endoparasitic, inclosed by the persistent skin of the pupa. Pupa larviform, apodous.

Head and thorax adnate, forming an acariform chitinized disk, separated by a constriction from the sac-like abdomen. This disk, the cephalothorax, protrudes from between the abdominal segments of the host, with the oral or ventral surface upwards. Mouth parts vestigial. Eyes lacking. Thorax separated ventrally from head by opening of brood canal, an intermembranal conduit between pupal and adult skins leading from the genital apertures on the second to fifth segments anteriad to this ventral slit.

Reproduction prolific, larviparous. Development endoparasitic and highly hypermetamorphic. Alimentation probably osmotic. Hosts various, hexapodal. First larvæ, or triungulinids, campodeiform hexapods. Parasitic stages apodous. Male pupal case, with cephalothorax protruded from the abdomen of the host, is merely the last larval skin with cap-like lid, or cephalotheca. The pupa is similar to those of the Coleoptera and Hymenoptera and lies free in its case.

Superfamily MENGEOIDEA Pierce, 1908.

Based on the family Mengeidæ.

Characterized by having the tarsi five-jointed, and with two tarsal claws.

1. Family MENGEIDÆ Pierce, 1908.

Based on the genus *Mengea* Grote (1886), which is fossil in amber.

Antennæ seven-jointed, third and fourth joints laterally produced.

The family contains two genera:

1. *Mengea* Grote (1886). Fossil in amber.
2. *Trioxocera* Pierce, host genus unknown. Mexico.

1. Genus MENGEA Grote (1886).

Trixena MENGE 1866 (preoccupied.)

Type-species.—*Mengea tertiaria* Menge (1866).

Wings having eight primary veins from base, with one distal unattached vein between the subcosta and radius, and with the first and second anal veins apically united.

1. MENGEA TERTIARIA Menge (1866).

Trixena tertiaria MENGE, 1866.
Mengea tertiaria GROTE, 1886.—PIERCE, 1908.

This species is fossil in amber, belonging to the Tertiary age, and occurring in Germany (pl. 1, fig. 1).

The following is a translation in part of Menge's original description of this species:

Male.—Length 3 mm., breadth between tips of expanded wings 7 mm. Color of body golden brown, wings whitish. Head convex, twice as wide as long. Vertex at apex broadly emarginate, prominent laminate. Mandibles short, three edged, apically acute. Maxillæ short, obtuse, bearing on the side a knife-like, single-jointed, pubescent palpus, which is about three times as long as the maxilla proper. Labial palpi absent. Surface very finely granulate, with scattered darker punctures. Eyes hemispherical, prominent, but not petiolate, with about forty separated ommatidia, each with a hemispherical cornea, and arranged in regular lines. Antennæ seven-jointed, first joint short, cylindrical; second top-shaped, as long as first; third long, on inner side produced in a flabellum almost twice as long as the joint itself; fourth joint also laterally produced, but with flabellum shorter; fifth and sixth joints top-shaped, of equal length with first and second; seventh joint cylindrical, obtuse at apex, almost as long as sixth and seventh together. The entire antennæ are very finely pubescent. Head separated from thorax by narrow commissure. Prothorax becoming broader behind; mesothorax somewhat broader and longer, with a sharply outlined scutellum; metathorax a little longer, narrowed behind into a long shield-like postscutellum, which reaches to the middle of the abdomen. Elytra reduced to short lobes. Hind wings subtriangular, almost as long as wide, with eight (costa and subcosta united) straight radial veins, and no cross-veins, but with several short longitudinal detached veins. Legs eight-jointed, the trochanters long and strong, somewhat curved, reversed top-shaped; femora twice as long, somewhat arcuate, cylindrical; tibiæ scarcely half as long as femora, reversed top-shaped; tarsi with first joint thickest, fifth longest, first reversed top-shaped, the following subcylindrical, the last joint bearing two lancet-shaped, three-angled, straight claws, without pulvillus; legs very finely pubescent. Abdomen ten segmented.[a]

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[a] *Male.*—Länge des Leibes 3 mm. Breite bei ausgespannten Flügeln 7 mm. Jetzige Farbe des Leibes gelblichbraun, die der Flügel weisslich. Kopf rundlich, doppelt so breit wie lang. Oberlippe, wie es scheint, ein breites am Vorderende abgerundetes Blättchen. Oberkiefer zwei kurze, dreieckige, spitze etwas vorstehende Zangen. Unterkiefer (maxillæ) kurz, dreieckig, stumpf. An der Seite derselben zwei messerförmige eingliedige fein behaarte Taster (palpus, or second joint of maxilla), etwa dreimal so lang als die Unterkiefer. Die Unterlippe so viel zu ersehen ist, dreilappig, ohne Taster, wenn nicht die beiden Seitenteile als solche anzusehen sind; der mittlere Teil durch eine schwache Furche in zwei Teile geteilt. Hinter derselben ein dreieckiges Kinn, bedeutend lang und breit. * * * Die Oberfläche ist sehr fein gekörnelt und mit einzelnen dunklern Punkten überstreut. * * * Augen halbkugelförmig, zu beiden Seiten stark vorgequollen, jedoch nicht gestielt, aus etwa vierzig, von einander getrennten Äuglein bestehend, jedes Äuglein mit halbkegelförmiger Hornhaut, die in der Mitte kreisförmig eingedrückt erscheint, bedeckt. * * * Fühler siebengliedrig, das erste Glied kurz, cylindrisch; das zweite kreiselförmig, eben so lang; das dritte länglich dreieckig, nach der Innenseite in einen cylindrischen, am Ende kegelförmigen, Seitenast verlängert, der fast doppelt so lang ist, wie das Glied selbst; das vierte Glied eben so gestaltet, der Seitenast jedoch etwas kürzer; das fünfte and sechste Glied kreiselförmig, mit dem ersten und zweiten fast von gleicher länge; das siebente Glied cylindrisch, stumpf zugespitzt, fast so lang wie das sechste und siebente zusammen. Das dritte und vierte Glied bildet mit den drei letzten vereint eine dreieckige Gabel. Alle Glieder sind mit feinen Härchen besetzt.

Der Kopf ist von der Brust durch einen schmälern Hals getrennt. Der Prothorax nach hinten sich verbreiternd, der Mesothorax etwas breiter und länger, oben mit einem stark ausgeschnittenen Schildchen bedeckt, der Metathorax wenig länger, sich nach hinten verschmälernd, oben in einen länglichen schildartigen Fortsatz auslaufend, der beinah bis zur Mitte des Hinterleibs reicht.

Vorderflügel auf zwei kurze linienförmige Stummel reducirt, die an der untern Seite rinnenförmig sind und am Ende durch Umschlagung des Randes eine löffelartige

2. TRIOXOCERA, new genus.

Type of genus.—Trioxocera mexicana, new species.

Name derived from τρία (three) + ὄζος (branch) + κέρας (horn) = three-branched antennæ.

Wings having seven primary veins from base, with one distal unattached vein beyond the tip of the radius, one long unattached vein beginning above and very near the medius, medius with two branches on the costal side; cubitus and second anal very heavy, first anal light, third anal lacking.

1. TRIOXOCERA MEXICANA, new species.

Described from two specimens collected by Dr. A. Fenyes at Cordoba, Vera Cruz, Mexico (fig. 3, nos. 1, 2; pl. 1, figs. 2, 3, 4).

Male.—Length 1.7 mm.; wing expanse 3.7 mm.; brown; lighter, yellowish below; wings clouded, veins dark and distinct. Head transverse; eyes prominent, normal; antennæ seven-jointed, first two joints transverse cup-shaped receiving the following joint, third even shorter cupped, inferiorly extended in a long flattened sensitive flabellum which points outward and lies closely under the following joint, extending almost as far and reaching beyond the base of the seventh joint; fourth joint similarly produced, the flabellum reaching almost to the middle of the seventh; fifth joint elongate becoming flattened like the flabelli, considerably longer than the two following; sixth joint about one-third the length of the fifth; seventh one-half longer than the sixth. The mouth parts can not be studied in the specimens at hand.

Wings with seven primary veins from base; the first two (costa + subcosta) strong, united, bracing the margin to its middle; parallel with this and very close to it is the third (radius) which is much lighter and not as long as the first, about opposite the tip of the subcosta a short wavy vein appears which is evidently an interrupted

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Vertiefung bilden. Doch sind die beiden Randadern (Costa u. Subcosta) angedeutet. Hinterflügel dreieckig, fast so lang wie breit; * * * der ganze Flügel stralenförmig mit sieben ziemlich geraden Längsadern durchzogen, ohne alle Queradern, aber mit vielen unregelmässigen Querfalten und einigen Längsfalten versehen. * * *

Füsse achtgliedrig, die Hüften (coxa) ziemlich lang und stark, etwas gekrümmt umgekehrt kegelförmig; die Schenkel (femur) doppelt so lang, etwas gebogen, cylindrisch, die Schienen (tibia) kaum halb so lang, umgekehrt kegelförmig. Von den Tarsengliedern ist das erste Glied das dickste, das fünfte das längste, das erste umgekehrt kegelförmig, die folgenden sich allmälich der Cylinderform annährend; am Ende des letzten Gliedes zwei lanzettförmig dreieckige, gerad ausgestreckte Krallen, ohne Haftpolster. Die ganzen Füsse unbewehrt und nur mit feinen kurzen Härchen bekleidet.' Der Hinterleib neungliedrig, in der Mitte wenig breiter als am Grunde, am Ende sich allmälig zuspitzend, von oben etwas flach gedrückt, die Ringe an den Seiten mit etwas flach gedrückt, die Ringe an den Seiten mit etwas vorstehenden Ecken. Die Oberfläche ist fein gekörnelt. Die fein behaarte stumpfe Spitze scheint das vorstehende Copulationsorgan zu sein. (Menge, 1866.)

continuation of the radius; the fourth primary (medius) arises contiguous to the second but rapidly diverges; between the bases of these two veins is a short darkened area, about the middle this vein sends off above a short slightly diverging branch indicated by an infuscation, beyond this and between the main vein and its branch is another infuscated branch which extends parallel and very close to the main vein to the outer margin of the wing; above all of these branches is an unattached infuscated vein beginning above the origin of the second branch and but a little distance from the main vein and extending to the outer margin of the wing; the fifth primary (cubitus) diverges from the medius at the same angle as the radius does from the medius; the sixth primary (first anal) is halfway between the cubitus and second anal and very strong; the seventh primary (second anal) diverges from the cubitus at the same angle as exists between the medius and cubitus, and extends to the margin. Anterior and median coxæ transverse; trochanters arising at the sides, as long as the femora, or tibiæ; posterior coxæ prominent, cylindrical, cupped; trochanters flared at apex, not as long as femora; tarsi five-jointed, first joint two-thirds as long as tibia, second almost half as long as first, third slightly shorter, fourth bilobed, fifth slender almost as long as the third, and armed with two long slender claws. Œdeagus long and slender, gently sinuate, acute at tip but not abruptly angulate near tip.

Type.—Cat. No. 10080, U.S.N.M.

Superfamily XENOIDEA Pierce, 1908.

Hymenopterobiæ (part) SAUNDERS, 1872.
Stylopinæ PERKINS, 1905.

Type-family.—Xenidæ Semenov.

Tarsi four-jointed.

The superfamily includes four families, all parasites of Hymenoptera.

2. Myrmecolacidæ Pierce, parasitic on Formicoidea.
3. Stylopidæ Kirby, parasitic on Apoidea.
4. Hylechthridæ Pierce, parasitic on Apoidea.
5. Xenidæ Semenov, parasitic on Apoidea, Vespoidea, Sphecoidea.

2. Family MYRMECOLACIDÆ Pierce, 1908.

Hymenopterobiæ (part) SAUNDERS, 1872.
Myrmecolacides SAUNDERS, 1872.

Type-genus.—*Myrmecolax* Westwood (1858).

Antennæ seven-jointed, third joint laterally produced, fourth short, others elongate; tarsi four-jointed.

The family includes *Myrmecolax* Westwood, parasitic on an unknown ant from Asia, and *Caenocholax* Pierce with unknown host from Mexico.

3. Genus MYRMECOLAX Westwood (1858).

Myrmecolax SAUNDERS, 1872.

Type of genus.—*Myrmecolax nietneri* Westwood (1858).

Name derived from *μύρμηξ* (an ant) + *κόλαξ* (parasite), meaning an ant parasite.

The genus is parasitic upon ants and at present is restricted to Southern Asia. It is separated from *Cænocholax* by the characters of the wing venation and by the extraordinary tenth abdominal segment of the latter.

Wings having eight primary veins from base, the medius curved upward and branched at right angles.

1. MYRMECOLAX NIETNERI Westwood (1858).

Myrmecolax nietneri SAUNDERS, 1872.—PIERCE, 1908.

The host is an undetermined formicid, collected at Ramboddo, Ceylon, by Herr Nietner on April 29 (pl. 1, figs. 5, 6).

Westwood's description is as follows:

> *Male.*—The eyes are large, the interstices being conically elevated; the front of the head is produced into two rounded lobes. The antennæ partake of the character of those of *Elenchus*, the first and second joints being very short, the third also very short but having its under apical angle produced into a long slender branch, of which the extremity had been injured; the three terminal joints are much longer and more slender than those of the genus *Stylops;* these joints are also more curved, and with the extremities dilated. In certain positions the third joint appears to be followed by a distinct but very short joint.
>
> The mandibles are long, very slender and curved, acute at the tips, whilst the maxillary palpi are long and compressed, with the first joint very short and the second long, occupying nearly the whole of the organ. The thorax does not appear to offer any material difference from that of the already described genera; the prothorax is narrow and ring-shaped, as is also the mesothorax, having the pseudelytra affixed at the posterior angles; the latter are clavate at the tips. The wings are traversed by four strong black veins, radiating from the base of the wing, exclusive of the costal portion; the second (medius or fourth primary) of these veins is curved at its extremity. The legs are very short, and the basal joint of the tarsus in one foot was observed to have its lower angle produced. (Westwood, 1858.)

4. CÆNOCHOLAX, new genus.

Name derived from *καινός* (strange, unusual, new) + *χόλαξ* (parasite); meaning an interesting new parasite.

Tarsi four-jointed, the first large and not closely united to the following; antennæ with first two joints short cylindrical, third laterally produced into a long flabellum, fourth transverse cylindrical, fifth, sixth, and seventh elongate flattened; wings with only six primary veins, with a short detached vein just below the apex of the radius, with the medius short and continued by a long detached vein commencing behind it and shortly before its apex, cubitus and third anal lacking.

The genus is based on *Cænocholax fenyesi* from Mexico.

1. CÆNOCHOLAX FENYESI, new species.

Described from four males collected by Dr. A. Fenyes, at Cordoba, Mexico, May 21, 1908 (fig. 3, nos. 3, 4; pl. 1, figs. 7, 8, 9, 10, 11).

Male.—Length 1–1.5 mm., wing expanse 3.25–3.5 mm. Dark brown, wings slightly infuscated, veins strong. Head transverse, considerably wider than thorax, eyes very large, faceted. Occiput prominent bearing the antennæ on each side. Antennæ seven-jointed; the first two joints transverse, cylindrical, cupped; third joint transverse, cupped, but produced outwardly beneath in a long flabellum, which is almost as long as the metathorax; fourth joint transverse, cylindrical; fifth elongate five-sixths as long as the width of the head; sixth seven-tenths as long as the fifth and slightly surpassed by the flabellum of the third; seventh four-fifths as long as the fifth. Face almost as wide at the thorax; mandibles arising at posterior corners of face at edge of eyes, chitinous, elongate, slender, and acute, almost as long as the sixth joint of the antennæ; maxillæ arising just behind the mandibles on the posterior margin of the occiput, the maxilla proper being a large globular fleshy organ, very sensitive, and bearing on the outer side about the middle a long slender palpus, almost twice as long as the mandibles and nearly as slender; oral orifice at a considerable distance from the bases of the appendages; occiput merely a narrow basal band. Thorax as in other genera, except that the scuti are united for some little distance in the middle behind the præscutum; balancers long. Wings with six primary veins; the first two consisting of the very short basal costa and the subcosta reaching the middle of the anterior margin; the third (radius) lies very close to the subcosta, runs parallel to it and considerably beyond and becomes thickened toward its apex; below the apex of the radius and close to it is a short, thickened unattached branch; the fourth primary (medius) is united to the radius at its base, but diverges rapidly, and only extends one-third of the distance to the margin; immediately below the medius and beginning about its middle is an unattached vein which runs parallel to the medius to its apex and thence straight onward to the outer margin; the fifth primary (first anal) diverges from the medius at almost twice the angle between radius and medius; the sixth primary (second anal) is shorter and united with the preceding for a little distance at its base. Front and middle coxæ transverse; trochanters arising at the sides and longer than the femora; tibiæ about as long as the femora; tarsi short, hardly more than half as long as the tibiæ, with the first joint cylindrical and as long as the three following, these three joints with pubescent pad beneath as in other genera. Posterior coxæ prominent, cylindrical; trochanters short. Tenth dorsal segment of abdomen a large, broad, almost circular plate, wider than the preceding segments and completely covering the ninth ventral. Ninth ventral elongate, overhung by the much larger tenth dorsal, with the œdeagus arising from its tip. Œdeagus chitinous, concave on the inner margin for two-thirds of the distance to the apex, then abruptly turned outward, making a very sharp process below; on the outer edge acutely curved outward opposite the inferior process and meeting the inner margin to form a very acute apex.

Named in honor of its collector, Dr. A. Fenyes, of Pasadena, Cal.

Type.—Cat. No. 10081, U.S.N.M.

3. Family STYLOPIDÆ Kirby, 1813, redefined.

Strepsiptera or *Stylopidæ* HOEVEN, 1850 (part).
Hymenopterobiæ (part) SAUNDERS, 1872.
Stylopides SAUNDERS, 1872.

Type-genus.—*Stylops* Kirby (1802).

Antennæ six-jointed, third laterally produced; tarsi four-jointed.

This family includes three genera, parasites of Andrenidæ.

5. *Stylops* Kirby (1802), parasitic on *Andrena;* Europe, America.
6. *Parastylops* Meijere (1909); Java.
7. *Halictostylops*, new genus, parasitic on *Halictus;* Europe.

The location of the third genus is uncertain, as no male has ever been seen; but since the female of *Halictostylops spencii* Nassonow resembles a *Stylops* female it is placed here. The genus may subsequently be found to fall near *Halictoxenos* in Xenidæ.

5. Genus STYLOPS Kirby (1802).

Stylops KIRBY, 1813.—CURTIS, 1828.—HOEVEN, 1850.—SAUNDERS, 1872.—PIERCE, 1908.

Type of genus.—*Stylops melittæ* Kirby (1802).

Name derived from στῦλος (pillar) + ὤψ (eye), = stalked eye.

Parasitic on the genus *Andrena.*

Curtis described this genus as follows:

> *Male.*—Antennæ inserted between the eyes near the crown of the head, membranous, perforated or punctured, composed of six joints, the basal one somewhat cup-shaped; second very short, transverse; third produced on the internal side into a dilated hollow lobe extending beyond the fifth joint; fourth large subclavate; fifth smaller subovate; sixth as long, ovate and compressed. Labrum wanting. Pharynx visible. Mandibles arising between the eyes, very remote, at their base conniving, long, slender, lanceolate and horny. Maxillæ large and robust, membranous, indistinctly pubescent, biarticulate. Prothorax and mesothorax very short rings, not so broad as head. Tarsi four-jointed, each with pulvillus, basal joint largest, terminal smallest and notched at tip (Curtis, 1828).

Female.—Cephalothorax rather abruptly narrowed behind stigmatal angle, subtriangular to ovate, more or less obtuse or truncate in front. Stigmata often prominent. Mouth ventral with mandibles on each side, rather broad and obtuse. Abdomen with five median genital canals on second to sixth segments (Nassonow, 1893 *a*).

Triungulinid. Body oblong, slightly narrowing posteriad. Tenth segment medianly cleft, forming two tubercles, each bearing a long stylet (Nassonow, 1893 *a*).

The genus contains the following species:

1. *melittæ* Kirby (1802), parasitic on *Andrena nigro-ænea* Kirby; England, Germany, Hungary.
2. *dalii* Curtis (1828), parasitic on *A. labialis* Kirby; England.
3. *childreni* Gray (Griffith, 1832), parasitic on *A. victima* Smith; Nova Scotia.
4. *spencii* Pickering (1835), parasitic on *A. tibialis* Kirby; England, Germany.
5. *aterrima* Newport (1847), parasitic on *A. trimmerana* Kirby; England.
6. *thwaitei* Saunders (1872), parasitic on *A. afzeliella* Kirby; England, France, Germany, Switzerland, Hungary.
7. *advarians* Pierce, parasitic on *A. advarians* Viereck; British Columbia.
8. *bipunctatæ* Pierce, parasitic on *A. bipunctata* Cresson; Nebraska Wisconsin, Indiana, Alabama.
9. *bruneri* Pierce, parasitic on *A. illinoiensis* Robertson; Nebraska, Illinois.
10. *californica* Pierce, parasitic on *A. subtilis* Smith; Southern California.
11. *claytoniæ* Pierce, parasitic on *A. claytoniæ* Robertson; Georgia, Illinois.
12. *cornii* Pierce, parasitic on *A. commoda* Smith; Wisconsin.
13. *crawfordi* Pierce, parasitic on *A. crawfordi* Viereck; Texas.
14. *cressoni* Pierce, parasitic on *A. cressoni* Robertson; Maine.
15. *dominiquei* Pierce, parasitic on *A. flessæ* Panzer; France.
16. *grænicheri* Pierce, parasitic on *A. nivalis* Smith; Wisconsin.
17. *hartfordensis* Pierce, parasitic on *A. hartfordensis* Cockerell; Georgia.
18. *hippotes* Pierce, parasitic on *A. hippotes* Robertson; Ohio.
19. *imitatrix* Pierce, parasitic on *A. imitatrix* Cresson; Texas.
20. *multiplicatæ* Pierce, parasitic on *A. multiplicata* Cockerell; Wisconsin.
21. *nasoni* Pierce, parasitic on *A. nasoni* Robertson; Pennsylvania.
22. *nassonowi* Pierce, parasitic on *A. carbonaria* Linnæus; Germany, Egypt.
23. *nubeculæ* Pierce, parasitic on *A. nubecula* Smith; Colorado.
24. *packardi* Pierce, parasitic on *A. placida* Smith; Massachusetts.
25. *polemonii* Pierce, parasitic on *A. polemonii* Robertson; Colorado.
26. *salicifloris* Pierce, parasitic on *A. salicifloris* Cockerell; Washington.
27. *solidulæ* Pierce, parasitic on *A. solidula* Viereck; Washington.

28. *sparsipilosæ* Pierce, parasitic on *A. sparsipilosa* Viereck; Maine.
29. *subcandidæ* Pierce, parasitic on *A. subcandida;* Southern California.
30. *swenki* Pierce, parasitic on *A. solidaginis* Robertson; Nebraska, Pennsylvania.
31. *ventricosæ* Pierce, parasitic on *A. ventricosa* Dours; Hungary.
32. *vicinæ* Pierce, parasitic on *A. vicina* Smith; New Hampshire, Connecticut, Canada, Massachusetts.
33. *vierecki* Pierce, parasitic on *A. texana profunda* Viereck; Texas.
34. *oklahomæ* Pierce, parasitic on *A. flavoclypeata miserabilis* Cresson; Oklahoma.

The following names have been used in *Stylops* and are now synonyms:

dahlii Friese (1906) =*dalii* Curtis (1828), Pierce.
haworthi Stephens (1829) =*melittæ* Kirby (1802), Saunders, 1872.
kirbii Leach (1814) =*melittæ* Kirby (1802), Saunders, 1872.
trimmerana Smith (1857) =*aterrima* Newport (1847), Saunders, 1872.

As the writer has seen none of the species hitherto described in the genus, a table may be given here based on the illustrations of such species. The only available character in the illustrations is the antenna. Hereafter species should also be separated by the shape of the œdeagus and length of maxillary joints, as well as relative lengths of antennal joints. The thorax and wing venation may also present good characters.

Partial key of males.

1. Fourth joint of antennæ subequal to or greater than the following two together... 2.
Fourth joint not as great as the sum of the two following.................... 5.
2. Fourth joint about twice as great as the two following together, third not reaching sixth laterally..*melittæ* Kirby.
Fourth joint hardly greater than sum of two following........................ 3.
3. Third joint laterally reaching beyond base of sixth, fifth and sixth subequal (Smith's 1857 and Griffith's 1832 figures disagree)..........*childreni* Gray.
Third joint laterally not reaching sixth... 4.
4. Fifth joint slightly longer than the sixth..................*spencii* Templeton.
Sixth joint acuminate, longer than fifth...................*dominiquei* Pierce.
5. Fourth and fifth joints subequal, shorter than sixth............*aterrima* Newport.
Fourth joint longer than fifth or sixth, sixth longer than fifth....*dalii* Curtis.
Fourth joint about twice as long as fifth, sixth longer than fifth....*crawfordi* Pierce.

Key to females.

In the genus *Stylops* the mandibles of the females show fewer points of difference than in the xenid genera, so the best key for differentiation of the species described herein will be one based on the comparative measurements of the various dimensions of the cephalothorax. In order to accurately study the females of the

Strepsiptera, the cephalothorax should be mounted on a slide in balsam. Good mounts can be obtained from dried specimens by running up through water, alcohol, xylol, and cedar oil to balsam.

The measurements are with a Bausch and Lomb stand, tube length 160, eyepiece 1, objective ½, with eyepiece micrometer; 1 space = .01062 mm. As the comparative dimensions are the sought-for characters, other microscopes will be just as available. The actual size of each species may be found with its description.

The following measurements were taken: The length is the distance from the base of the flattened cephalothorax to the apex of the same; the distance from spiracle to apex is measured from the apical edge of the spiracle; the breadth between the mandibles is the shortest distance between the same; the breadth of the head is measured from the posterior lateral angles of the head, which in most species is indicated by a slight convex or concave angle, and by the lateral extension of the ventral slit which represents the base of the head; the breadth of the cephalothorax at the spiracles is measured between the outermost points of the spiracles; the greatest breadth of the cephalothorax is generally equal to the preceding, although it sometimes occurs behind the spiracles.

Species.	1. Length.	2. Spiracle to apex.	3. Breadth between mandibles.	4. Breadth head.	5. Breadth at spiracles.	6. Greatest breadth.
solidulæ	130.0	90.0	18.0	66.0	119.0	119.0
cornii	119.0	85.0	15.0	69.0	115.0	115.0
	113.0	78.0	14.0	57.0	105.0	105.0
vicinæ	106.0	76.0	16.0	61.0	107.0	107.0
grænicheri	104.0	76.0	14.5	63.0	119.0	119.0
crawfordi	98.0	69.0	15.0	59.0	107.0	107.0
saliciforis	96.0	69.0	14.0	61.0	98.0	98.0
advarians	89.5	64.5	15.0	52.0	91.0	91.0
californica	84.0	60.0	12.0	58.0	91.0	91.0
imitatrix	84.0	54.0	11.0	49.0	84.0	84.0
cressoni	83.0	56.0	12.0	46.5	86.0	86.0
multiplicatæ	82.0	56.0	12.0	49.0	85.5	85.5
nubeculæ	79.5	56.5	12.0	48.0	89.0	89.0
claytoniæ	79.5	51.5	10.0	45.0	77.0	77.0
hippotes	79.0	50.0	12.5	50.0	78.5	78.5
swenki	78.0	55.0	14.5	57.0	91.0	91.0
vierecki	78.0	54.0	12.0	50.0	81.0	81.0
bipunctatæ	73.5	51.5	11.0	43.0	71.0	73.0
subcandidæ	71.0	46.0	10.0	45.0	73.0	75.0
nasoni	69.0	48.0	9.0	39.0	70.0	70.0
sparsipilosæ	68.5	47.5	10.0	44.0	73.0	73.0
bruneri	68.0	37.0	9.5	46.0	63.0	63.0
hartfordensis	65.0	46.0	10.5	41.0	64.5	66.5
polemonii	55.0	37.0	7.0	29.5	49.0	51.0

Following is a comparison of dimensions by ratio. The first column represents the ratio of the breadth of the cephalothorax between the spiracles to the distance between the mandibles; the second represents the ratio of the breadth of the head to the distance between the mandibles; the third the ratio of the breadth between the spiracles to the breadth of the head; the fourth the ratio of the breadth between the spiracles to the distance from spiracle to apex. The species are arranged in the same order as in the preceding table.

Species.	Cephalothorax to mandibles. (5):(3)::—:1.[a]	Head to mandibles. (4):(3)::—:1.	Cephalothorax to head. (5):(4)::—:1.	Breadth to length. (5):(2)::—:1.
solidulæ	6.61	3.66	1.80	1.32
cornii	7.50–7.66	4.07–4.60	1.66–1.84	1.34–1.35
vicinæ	6.68	3.81	1.75	1.40
grænicheri	7.12	4.34	1.88	1.56
crawfordi	7.13	3.93	1.81	1.55
saliciflorïs	7.00	4.35	1.60	1.42
advarians	6.06	3.46	1.75	1.41
californica	7.58	4.83	1.56	1.51
imitatrix	7.63	4.45	1.71	1.55
cressoni	7.16	3.87	1.84	1.53
multiplicatæ	7.12	4.06	1.74	1.52
nubeculæ	7.41	4.00	1.85	1.57
claytoniæ	7.70	4.50	1.71	1.49
hippotes	6.28	4.00	1.77	1.77
swenki	6.27	3.93	1.59	1.65
viereckí	6.75	4.16	1.62	1.50
bipunctatæ	6.45	3.90	1.65	1.37
subcandidæ	7.30	4.50	1.62	1.58
nasoni	7.77	4.33	1.78	1.45
sparsipilosæ	7.30	4.40	1.65	1.53
bruneri	6.63	4.84	1.36	1.79
hartfordensis	6.14	3.90	1.57	1.40
polemonii	7.00	3.91	1.66	1.32
oklahomæ	9.57	5.52	1.73	1.43

[a] These ratios refer to the numbers at the head of the preceding table.

This study of comparative dimensions is sufficient to show any one that the species may be easily distinguished. To facilitate identification the writer has illustrated a female of each species and given the mandibular character prominence. No relationship can be found between the parasites and the artificial subgenera designated for *Andrena* by Robertson.

1. STYLOPS MELITTÆ Kirby (1802).

Stylops kirbii LEACH, 1814.
Stylops haworthi STEPHENS, 1829.
Stylops melittæ SAUNDERS, 1872.

Host.—Andrena nigro-aenea Kirby; England, Germany, Hungary (fig. 2, no. 14; pl. 2, fig. 4).

The following description is drawn from Kirby's original description:

Male.—Black, with feet fuscous. Length, 1½ lines. Head anteriorly obsoletely tri-lobed. Antennæ six-jointed; first joint longer than second, clavate or obconic, apically obliquely truncate; second very short, cylindrical; third short, inferiorly produced in a long lanceolate, subauriform, compressed flabellum; fourth longer, sublinear, outwardly a little broader; fifth short; sixth very short, apically rounded, tenuate. Mandibles a little inflated toward apex. Maxillæ obconic, compressed; with the palpus semiovate, acute, concave beneath. Eyes large, prominent. Vertex rather flat. Elytra small, sublinear. Wings large, longer than the body, folded, white, with costal margin dark. Postscutellum elongate, covering abdomen. Feet compressed, piceous.[a]

From the figures of this species (Kirby, 1806; Smith, 1857) the following may be added: Third joint of antennæ laterally not quite reaching sixth; fourth equal to twice fifth plus sixth.

2. STYLOPS DALII Curtis (1828).

Stylops melittæ dahlii Friese, 1906.
Stylops dalii Pierce, 1908.

Host.—*Andrena labialis* Kirby, England.

Male.—Length 3.5 mm., wing expanse 7.8 mm.

The following is Curtis's description:

> Intense velvety black. Palpi with the second joint much smaller than the first. Antennæ with the second joint very minute, and the fifth shorter than the sixth. Scutellum at the base and abdomen at the sides ochraceous. Superior wings or elytra fuscous, inferior wings emarginate at the posterior edge and narrowed toward the anal angle; milky white, iridescent, the costa fuscous as well as several of the nervures at the base. Legs fuscous. (Curtis, 1828.)

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[a] *Male.*—St(ylops) aterrima; alis corpore majoribus; pedibus fuscis.

Long. corp. lin. 1½.

Corpus aterrimum, obscurum. Caput antice obsolete trilobum. (Saunders, 1872, 27, from Kirby, 1802.)

Antennæ bipartitæ [sexarticulatæ], ramis compressis, superiori articulato; stipite biarticulato; articulo primo sequente longiori, clavato vel obconico; apice oblique truncato; secundo brevissimo, cylindrico, ramos duos emittente (sic); inferiori [articulo 3tio] paulo breviori, lanceolato et fere auriformi, compresso, exarticulato, supra concavo; superiori compresso, triarticulato; articulo primo [4to] longiori, sublineari, extrorsum paulo latiori; secundo [5to] brevi, tertio [6to] brevissimo, apice rotundato, linearibus, tenuioribus.

Mandibulæ apice paulo crassiores.

Palpi (maxillæ) articulo primo, obconico, compresso; secundo semiovato, acuto; subtus concavo. (Saunders, 1872, 26, from Kirby, 1813.)

Oculi magni prominuli, conspicue reticulati, pedunculo brevi, crasso, insidentes. Vertex planiusculus.

Truncus: Elytra parva, sublinearia, thoracis lateribus affixa. Alæ magnæ, corpore longiores, plicatæ, lacteæ, costâ lineolâque submarginali, nigricantibus. [Pro-] scutellum [postscutellum, Aud.] (this latter is the correct) porrectum, elongatum, calceiforme, abdomen obtegens; processu corneo utrinque munitum. Pedes compressi picei. Abdomen, sub scutelli tegmine delitescens, carnosum, ano truncato, subemarginato. (Saunders, 1872, p. 27, from Kirby, 1802.)

Further amplification of this description may consist in the following, drawn from the illustrations of the species (Curtis, 1828; Smith, 1857): Third joint of antennæ laterally reaching about to middle of sixth; fourth and sixth subequal, and a little longer than fifth.

3. STYLOPS CHILDRENI Gray (Griffith, 1832).

Stylops childreni SMITH, 1857.—SAUNDERS, 1872.—PIERCE, 1908.

Host.—Andrena victima (?) Smith; Nova Scotia.

Type in British Museum.

According to Saunders it may be described as follows:

Male.—Sooty black, with antennæ and maxillæ piceous, abdomen luteopiceous; feet rufescent; wings pale fuscous, iridescent, with anterior margin darker.[a]

From Smith's (1857) drawing of the type the following characters may be assumed: Third joint of antennæ laterally almost reaching tip of sixth; first joint short, not much longer than sixth; fourth subequal to fifth plus sixth.

The typical species has not been found in this country since its first record. It must be thoroughly understood that the writer has found no species parasitic on two distinct species of Andrena. Packard's references to *Stylops childreni* were based on parasites of *Andrena placida* in Massachusetts, to which species the writer gives the name *Stylops packardi*, and upon parasites of *Andrena vicina* in Massachusetts which the writer herein describes as *Stylops vicinæ*.

4. STYLOPS SPENCII Pickering (1835).

Stylops spencii WESTWOOD, 1840.—SAUNDERS, 1872.—PIERCE, 1908.
Stylops melittæ NASSONOW, 1893*a*.
Stylops melittæ spencei FRIESE, 1906.

Host.—Andrena tibialis Kirby; England, Germany.

The original description by Pickering is as follows:

> *Male.*—Specifically distinguished by its comparatively large size; dark wings, marked with strong black nervures; basal joint of antennæ produced obliquely internally to a considerable distance beyond the insertion of the second joint; by the shape of the wings, which are produced at the external anterior angle to a point (not literally true) and are very broad and rounded behind; and by the pitchy red anus. (Pickering, 1835.)

From the figures of the species published by Pickering the following may be added: Third joint of antennæ not attaining tip of fifth, fourth joint greater than fifth plus sixth. Mandibles short, slender, and very acute, slightly longer than first joint of maxillæ. Maxillæ two jointed on a tuberculate base, with second joint once and one-half longer than first.

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[a] *Male.*—Fuliginosa, antennis palpisque piceis; abdomine luteopiceo; pedibus rufescentibus; alis pallide fuscis, iridescentibus, margine antico obscuriore. (Saunders, 1872.)

Female.—Cephalothorax light brownish with slightly concave dark band at base; as long as broad, apically sinuately truncate; truncation a little over one-fourth the width at the spiracles. Lateral margin convex. Spiracles dorsal, not reaching lateral margin.

This description is imperfect, as it is drawn from the figure (Nassonow, 1893 *a*, pl. 1, figs. 2, 3, 5).

5. STYLOPS ATERRIMA Newport (1847).

Stylops trimmerana (=*melittæ?*) SMITH, 1857.
Stylops aterrima SAUNDERS, 1872.—PIERCE, 1908.
Stylops melittæ aterrima FRIESE, 1906.

Host.—*Andrena trimmerana* Kirby; England, April, May.

According to Saunders the description is as follows:

Male.—Similar to *Stylops melittæ*, but with occipital margin of head deeply excised; antennæ, head, thorax, legs, and abdomen black.[a]

Smith (1857) reproduces Newport's figure of *aterrima* and gives his own figure of *trimmerana* which is from a fresh specimen. Both figures agree on the following points: The first joint of the antennæ is long; the second very short; the third produced laterally and parallel to the remainder attaining a point beyond the beginning of the sixth; the fourth, fifth, and sixth joints subequal, the sixth longer than the fifth.

6. STYLOPS THWAITEI Saunders, 1872.

Stylops dalii THWAITES, 1841.
Stylops thwaitei SAUNDERS, 1872.—PIERCE, 1908.
Stylops thwaitesei SAUNDERS, manuscript correction.

Host.—*Andrena afzeliella* Kirby; England, France, Germany, Switzerland, Hungary. (See Host List for references.)

This might be considered a *nomen nudum* if it were not for the fact that the host determines the parasite. Hence it may be expected that a valid description of the species will shortly be forthcoming from Europe.

It is very unfortunate that the name was published incorrectly.

7. STYLOPS ADVARIANS, new species.

Host.—*Andrena advarians* Viereck (det. H. L. Viereck); Vancouver, British Columbia, April 5, 1902. Described from one specimen received from H. L. Viereck (pl. 3, fig. 1).

Female.—Length of cephalothorax 0.95 mm., breadth at spiracles 0.96 mm., breadth at base of head 0.55 mm., distance between mandibles at base 0.16 mm. Cephalothorax light yellowish brown with dark brown transverse band at base; as long as broad, trapezoidal broadly truncate at apex; truncation about one-third breadth at spiracles. Mandibles broadly rounded with acute outwardly curved tooth at inner apex. Mouth broadly rounded, subquadrate. Spiracles prominent.

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[a] *Male.*—*S. melittæ* simillima, sed capitis margine occipitali profunde exciso; antennis, capite, thorace, (alis?) pedibus, abdomineque aterrimis. (Saunders, 1872.)

Type.—Cat. No. 10082, U.S.N.M.

8. STYLOPS BIPUNCTATÆ, new species.

Host.—*Andrena bipunctata* Cresson; Indiana, collected by C. F. Baker. Described from one specimen from the Carl F. Baker collection of the U. S. National Museum.

Female.—Length of cephalothorax 0.78 mm., breadth at spiracles 0.75 mm., breadth at base of head 0.45 mm., distance between mandibles at base 0.16 mm. Cephalothorax light yellowish brown with narrow dark transverse band at base; slightly longer than broad, deltoid, broadly truncate at apex; truncation about one-third breadth at spiracles. Head slightly constricted laterally at base of mandibles. Mandibles oblique, broadly rounded with acute outwardly curved tooth at apex, and a second tooth about middle of outer side below. Mouth almost round. Spiracles dorsal, not reaching lateral edge.

Paratypes with the following records were also studied: Polk County, Wisconsin, C. F. Baker; Alabama, C. F. Baker; Sioux County, Nebraska, May, L. Bruner; Milwaukee, Wisconsin, April 17, 1902, S. Graenicher. The outer tooth of the mandibles is not as distinct in these as in the type.

Type.—Cat. No. 10083, U.S.N.M.

9. STYLOPS BRUNERI, new species.

Host.—*Andrena illinoiensis* Robertson; Sioux County, Nebraska, May, L. Bruner, collector. Described from one specimen from the collection of the University of Nebraska (pl. 3, fig. 2).

Female.—Length of cephalothorax 0.72 mm., breadth at spiracles 0.66 mm., breadth at base of head 0.48 mm., distance between mandibles at base 0.1 mm. Cephalothorax light yellowish brown with narrow dark transverse band at base; slightly longer than broad, elongate trapezoidal, broadly truncate at apex, truncation a little over one-third breadth at spiracles. Mandibles with sides rounded to outwardly curved acute apical tooth, and with obtuse subbasal tooth on ventral side near outer edge. Spiracles laterally prominent.

Paratypes with the following record were also studied: Lincoln, Nebraska, April (two individuals).

Type.—Cat. No. 10084, U.S.N.M.

Dedicated to the honor of Prof. Lawrence Bruner, of the University of Nebraska, the collector of the type specimen, and to whom the author owes his preparation in entomology.

10. STYLOPS CALIFORNICA, new species.

Host.—Andrena subtilis Smith; Southern California. Described from two females and their triungulinids from one bee in the collection of the University of Nebraska.

Female.—Length of cephalothorax 0.89 mm., breadth at spiracles 0.96 mm., breadth at base of head 0.61 mm., distance between mandibles at base 0.14 mm. Cephalothorax light brownish, with narrow darker transverse band at base; slightly broader than long, broadly rounded truncated at apex; truncation about two-ninths the breadth at spiracles. Mandibles very broadly rounded, armed at apex with outwardly curved acute tooth. Mouth large, round. Spiracles laterally prominent.

Type.—Cat. No. 10085, U.S.N.M.

Triungulinid: Length of body 0.15–0.18 mm., length including stylets 0.21–0.23 mm., breadth of head 0.04 mm., greatest breadth 0.06 mm., breadth of ninth abdominal segment 0.02 mm. Color, yellow to brown. The head is transverse, subreniform, with the reddish brown eye patches occupying a considerable space at each side. The antennæ are very minute, only visible under the highest powers. The mouth parts are very indistinct. The legs consist of coxa, femur, tibia, and tarsus. The femur is short and armed with a long spine; the tibia is twice the length of the femur; the acute, transparent, one-jointed tarsus is about equal to the tibia. The abdominal segments are freely bordered with transparent spines of two sizes, alternating regularly. The tenth abdominal segment is cloven into two tubercles each bearing a single stylet, which is almost equal to half the length of the body.

11. STYLOPS CLAYTONIÆ, new species.

Host.—Andrena (*Trachandrena*) *claytoniæ* Robertson (det. H. L. Viereck); Thomasville, Georgia, March 21, 1904; M. Hebard, collector (pl. 3, fig. 3).

Female.—Length of cephalothorax 0.84 mm., breadth at spiracles 0.81 mm., breadth at base of head 0.47 mm., distance between mandibles at base 0.13 mm. Cephalothorax light yellowish brown with dark brown transverse band at base; as long as broad, wedge shaped, narrowly rounded truncate at apex, apical margin shallowly emarginate, truncation less than one-third breadth at spiracles. Lateral margin slightly constricted at base of mandibles and at base of head. Mandibles oblique, broad, with outwardly curved tooth at apex and blunt tooth about middle of outer edge. Mouth elliptical. Spiracles only slightly prominent.

Type.—Cat. No. 10086, U.S.N.M.

12. STYLOPS CORNII, new species.

Host.—Andrena commoda Smith (*corni* Robertson, det. S. Graenicher); Milwaukee, Wisconsin, June 17, 1906; S. Graenicher. Described from one female and its triungulinids, presented by Dr. Sigmund Graenicher, of Milwaukee (pl. 3, fig. 4).

Female.—Length of cephalothorax 1.20 mm., breadth at spiracles 1.11 mm., breadth at base of head 0.60 mm., distance between mandibles at base 0.15 mm. Cephalothorax light brownish with dark brown transverse band at base; a little longer than broad, wedge shaped, roundingly truncated at apex; truncation less than one-third breadth at spiracles. Head slightly constricted laterally at base of mandibles; edge from this point to spiracles convex. Mandibles broadly rounded, armed at apex with outward pointing tooth, and at basal third of outer margin with small tumidity. Mouth elliptical. Spiracles laterally prominent.

A paratype collected at the same place June 2, 1902, has the following dimensions: Length of cephalothorax 1.26 mm., breadth at spiracles 1.22 mm., breadth at base of head 0.73 mm., distance between mandibles at base 0.20 mm. The difference between these two is probably very near to the extreme variation in size.

Triungulinid: Length of body 0.21–0.22 mm., length including stylets 0.31–0.35 mm., breadth of head 0.037–0.042 mm., greatest breadth 0.066 mm., breadth of ninth abdominal segment 0.03 mm. The characters are essentially the same as those described for *Stylops californica.*

Type.—Female and triungulinids, Cat. No. 10087, U.S.N.M.

13. STYLOPS CRAWFORDI, new species.

Host.—Andrena Crawfordi Viereck (det. H. L. Viereck). Described from two males collected at Dallas, Texas, April 27 and 28, 1906, and from many females collected by Mr. J. C. Crawford and the author (fig. 3, nos. 5, 6; pl. 2, figs. 5, 6, 8, 9, 10, 11, 12; pl. 3, fig. 5).

Male.—Color black; antennæ and legs brown; last two abdominal segments flavous; wings hyaline, with veins light brown. Length of body 4.5 mm., length of head and thorax 3.5 mm., breadth of head 1.05 mm., length of antennæ 1.36 mm., length of oedeagus 0.40 mm. Antennæ with first two joints short, subequal, cupped at apex; third joint laterally reaching to about the middle of the sixth; joints 3 to 6 in the proportion of 65, 36, 18, 21.5. Mandibles subcylindrical, tapering on dorsal edge, but apically flattened laterally and toward tips somewhat enlarged, then obliquely truncate. Palpi not quite as long as fourth and fifth antennal joints, with basal joint longer than the apical. Œdeagus at base triangularly truncate externally, at basal one-third with a long shallow emargination on external edge, at apical one-third abruptly bent outwards in a rounded right angle, tapering to a point, the inner edge convex from apex to tip of sharp process at apical third. The inner process is only about one-fourth the length of the outer or apical process. This type of œdeagus is unique and represented only by *Stylops*.

Male.—Cephalotheca: Length 1.02 mm., breadth 1.66 mm. Transverse, broadly elliptical, convex, the eyes occupying over one-half the width. Face divided medianly by the broad arcuate margin of the vertex. The vertigial margin extends only two-thirds of the distance from the center to each eye. Above the ends of this margin and extending almost to the eyes are the large subcircular antennal analogues, which are indicated by several faint concentric rings and by a granular structure in the center, composed of about fifteen minute granules. These analogues are less than one-fourth their diameter from the eyes. Below the vertigial margin is a transverse arched area bounded below by a pronounced line subparallel with the vertigial margin and equal to it. This strip, which may be a labral or clypeal analogue, has a punctured surface in distinction from the upper part of the pharyngeal area which is distinguished by a mass of close sinuate lines. The entire pharyngeal area is keystone shaped, roughly divided by sculpture into two areas of which the upper has just been described. It is laterally emarginate for the mandibular analogues, between which it contains the opening of the pharynx. The lower part of the pharyngeal area is of the same shape as the whole area, and begins at the opening of the pharynx. The mandibular analogues are sharply defined and prominent, being slightly closer to the pharyngeal opening than to the eyes. From these a narrow oblique strip extends to the lower margin and borders the eyes. Between this strip and the pharyngeal area lies a subcircular area in the center of which is the maxillary analogue. The latter analogues are distant from the mandibular by their own diameters and from each other by about three times their diameter. The labial analogue is a narrow marginal strip.

Female.—Length of cephalothorax 1.04 mm., breadth at spiracles 1.13 mm., breadth at base of head 0.62 mm., distance between mandibles 0.15 mm. Cephalothorax light yellowish brown, margin darker, especially at the front of the head, and the sides of the metathorax behind the spiracles; a very dark band on the abdomen sharply defines the limits of the cephalothorax. Cephalothorax slightly broader than long, trapezoidal, squarely truncate at apex; truncation less than one-fourth the breadth at the spiracles. Lateral margin slightly constricted at base of mandibles, at base of head, a little over half way from base of head to spiracles, and just before the spiracles; margin from spiracles to base of cephalothorax almost rectangularly bent. Mandibles obtuse with a prominent tooth at the apical third on the inner margin. Posterior margin of oral orifice angularly emarginate. Spiracles lateral, but hardly prominent.

A large series of this species were collected, and much of the material in the biological portion of this article was obtained from the study of this species and its relations to its hosts.

Type.—Cat. No. 10088, U.S.N.M.

Dedicated to the writer's friend, Mr. J. C. Crawford, who discovered the host as well as the parasite.

14. STYLOPS CRESSONI, new species.

Host.—*Andrena* (*Opandrena*) *cressoni* Robertson (det. H. L. Viereck); Waldoboro, Maine, on *Viburnum*, June 16. Described from one female and its offspring from the collection of H. L. Viereck (pl. 3, fig. 6).

Female.—Length of cephalothorax 0.88 mm., breadth at spiracles 0.91 mm., breadth at base of head 0.49 mm., distance between mandibles at base 0.13 mm. Cephalothorax light yellowish brown with dark brown band at base equally divided by basal line of cephalothorax; slightly broader than long, broadly trapezoidal, truncate at apex; truncation one-third the breadth between the spiracles. Lateral margin constricted at base of mandibles, rather wavy thence to spiracles. Mandibles obtuse, armed with outwardly curved tooth at inner apex, emarginate on outer apical angle. Mouth elliptical. Spiracles dorsal, just barely surpassing margin.

Triungulinid: Length of body 0.13–0.15 mm., length including stylets 0.20–0.24 mm., breadth at base of head 0.03 mm., greatest breadth 0.05 mm., breadth of ninth abdominal segment 0.03 mm.

The characters are in general the same as described for *Stylops californica.*

Type.—Cat. No. 10089, U.S.N.M.

Named in honor of the eminent Hymenopterist, Mr. **Ezra T.** Cresson, to whose honor the host has already been dedicated.

15. STYLOPS DOMINIQUEI, new species.

Stylops, species, DOMINIQUE, 1891.

In order to facilitate reference, the species figured by J. Dominique has been named in his honor. The figures and the host species with its type locality are sufficient to identify the parasite. The immense number of host records with no indication of the characters of the parasites makes it convenient when such characters are mentioned to have some specific name by which the parasite may be known. It is the writer's practice in most cases to designate the parasite by the name of the host, or by the name of the discoverer.

Host.—*Andrena flessæ* Panzer; Nantes, France, April. The figures were based upon the parasites from a quadristylopized *andrena.*

Male.—The male can be sufficiently differentiated from any others described by means of the antennæ alone, and has thus been separated in a table at the beginning of this genus.

16. STYLOPS GRÆNICHERI, new species.

Host.—*Andrena nivalis* Smith; Milwaukee, Wisconsin, June 11, 1901; S. Graenicher, collector. Described from one specimen presented to the writer by Doctor Graenicher (pl. 3, fig. 7).

Female.—Length of cephalothorax 1.10 mm., breadth at spiracles 1.26 mm., breadth at base of head 0.66 mm., distance between mandibles at base 0.19 mm. Cephalothorax light brown with dark transverse band at base; broader than long, convexly truncate at apex, sides convex, slightly constricted at base of mandibles; apical truncation about two-ninths of the breadth at spiracles. Mandibles obtuse, armed at apex with outward curving tooth, and tuberculate at basal third of outer edge. Mouth elliptical. Spiracles lateral, very prominent.

Type.—Cat. No. 10090, U.S.N.M.

This species is dedicated to the honor of Dr. Sigmund Graenicher, the collector, who has done such excellent work on the biologies and flower relations of the bees in his neighborhood.

17. STYLOPS HARTFORDENSIS, new species.

Host.—*Andrena hartfordensis* Cockerell (det. H. L. Viereck); Thomasville, Georgia, March 27, 1902. Described from one specimen (pl. 3, fig. 8).

Female.—Length of cephalothorax 0.69 mm., breadth of spiracles 0.67 mm., breadth at base of head 0.43 mm., distance between mandibles at base 0.12 mm. Cephalothorax light yellowish, with broad dark-brown band at base; slightly longer than broad, elongate trapezoidal, squarely truncate at apex; truncation a little more than one-third the breadth at the spiracles. Lateral margin almost straight from apical truncation to spiracles except for a constriction at the base of the mandibles. Mandibles blunt with very prominent outward curving tooth at apex, and with a large tumidity at the middle of the outer edge. Mouth elliptical, posterior margin almost straight. Spiracles dorsal, barely perceptible on lateral margin.

Type.—Cat. No. 10091, U.S.N.M.

18. STYLOPS HIPPOTES, new species.

Host.—*Andrena* (*Trachandrena*) *hippotes* Robertson (det. H. L. Viereck); Columbus, Ohio, April 21, 1902; J. C. Bridwell, collector. Described from one female (pl. 3, fig. 9).

Female.—Length of cephalothorax 0.83 mm., breadth at spiracles 0.83 mm., breadth at base of head 0.53 mm., distance between mandibles at base 0.15 mm. Cephalothorax light yellow with brown band at base, half on the thorax and half on the first abdominal; as long as broad, subtrapezoidal, squarely truncate at apex; truncation less than one-third the breadth at the spiracles. Lateral margin sinuate. Mandibles rounded, obtuse, with a small acute, curved tooth at apex. Posterior margin of mouth straight. Spiracles dorsal, just reaching lateral margin.

Type.—Cat. No. 10092, U.S.N.M.

19. STYLOPS IMITATRIX, new species.

Host.—*Andrena* (*Trachandrena*) *imitatrix* Cresson (det. H. L. Viereck); Round Mountain, Texas. Described from one female (pl. 3, fig. 10).

Female.—Length of cephalothorax 0.89 mm., breadth at spiracles 0.89 mm., breadth at base of head 0.52 mm., distance between mandibles at base 0.14 mm. Cephalothorax light yellowish brown with a darker-brown band at base; as long as broad, truncate deltoid; truncation less than one-fourth the breadth at the spiracles. Lateral margin slightly constricted at base of mandibles and at base of head. Mandibles subquadrate with large tooth at inner apical angle and with blunt prominent tooth on outer edge at middle. Posterior margin of mouth straight. Spiracles dorsal, just reaching lateral margin.

Type.—Cat. No. 10093, U.S.N.M.

20. STYLOPS MULTIPLICATÆ, new species.

Host.—*Andrena multiplicata* Cockerell; Milwaukee, Wisconsin, June 9, 1904, May 2, 1904; S. Graenicher, collector. Described from two females presented to the writer by Doctor Graenicher (pl. 3, fig. 11).

Female.—Length of cephalothorax 0.87 mm., breadth at spiracles 0.90 mm., breadth at base of head 0.62 mm., shortest distance between mandibles 0.12 mm. Cephalothorax light yellowish brown with black band at base, half on the thorax and half on the first abdominal; almost as long as broad, subtrapezoidal, truncate at apex; truncation less than one-fourth the breadth at the spiracles. Lateral margin slightly convex. Mandibles subquadrate, with an acute curved tooth at inner apex and slight indication of a convex protuberance on outer edge midway between inner tooth and base. Spiracles laterally prominent.

Type.—Cat. No. 10094, U.S.N.M.

21. STYLOPS NASONI, new species.

Host.—*Andrena nasoni* Robertson (metatype det. H. L. Viereck); Ashbourne, Pennsylvania, April 19, 1897. Described from one female (pl. 4, fig. 1).

Female.—Length of cephalothorax 0.73 mm., breadth at spiracles 0.74 mm., breadth at base of head 0.41 mm., distance between mandibles 0.09 mm. Cephalothorax light yellowish brown with narrow dark-brown band at base, half on the thorax and half on the first abdominal; as long as broad, truncate wedge-shaped, edges very nearly straight, angles sharp; truncation less than one-third the breadth at the spiracles. Mandibles rounded with an outward curved tooth at apex. Spiracles laterally prominent.

Type.—Cat. No. 10095, U.S.N.M.

22. STYLOPS NASSONOWI, new species.

Stylops mellittae Nassonow, 1893 *a*.

Host.—*Andrena carbonaria* Fabricius; recorded parasitized from Germany and Egypt.

Female.—Cephalothorax light brownish with concave dark band at base; slightly longer than broad, narrowly and squarely truncate at apex; truncation a little less than one-fourth the breadth at the spiracles. Lateral margin convex. Spiracles laterally prominent.

This description is imperfect, as it is drawn from the figure (Nassonow, 1893 *a*, pl. 1, figs. 1, 7).

23. STYLOPS NUBECULÆ, new species.

Host.—*Andrena nubecula* Smith (det. H. L. Viereck); Colorado; C. F. Baker, collector. Described from one female from the Baker collection of the U. S. National Museum (pl. 4, fig. 2).

Female.—Length of cephalothorax 0.84 mm., breadth of spiracles 0.94 mm., breadth at base of head 0.51 mm., distance between mandibles 0.12 mm. Cephalothorax light yellowish brown with convex dark-brown band at base, half on the thorax and half on the first abdominal, the convexity filled with a lighter brown, and the band laterally interrupted before reaching the spiracles; broader than long; wedge shaped, narrowly and convexly truncate at apex; truncation slightly less than one-third the breadth at the spiracles. Lateral margin almost straight, slightly sinuate. Mandibles broad, subquadrate with an outward curved tooth at inner edge, outer edge rounded. Posterior margin of mouth rounded. Spiracles lateral, but not very prominent.

Type.—Cat. No. 10096, U.S.N.M.

24. STYLOPS PACKARDI, new species.

Stylops childreni Packard, 1864, 1872.

Host.—*Andrena placida* Smith; Salem, Massachusetts, April 29, on Mezereon; collected by A. S. Packard.

Professor Packard originally described this species as follows:

> *Male.*—The whole body, the antennæ, and the appendages of the mouth were velvety black; abdomen slightly brownish; legs and anal forceps pale resinous brown; the tarsal joints, and tips of tibiæ pale testaceous (Packard, 1864).

This name also is given in order to straighten out the synonymy and with the assurance that material will soon be forthcoming from which more accurate descriptions can be made.

25. STYLOPS POLEMONII, new species.

Host.—*Andrena polemonii* Robertson (?); Colorado; C. F. Baker, collector. Described from one female and its triungulinids from the Baker collection of the U. S. National Museum (pl. 4, fig. 4).

Female.—Length of cephalothorax 0.58 mm., breadth at spiracles 0.52 mm., breadth of base of head 0.31 mm., distance between mandibles at base 0.07 mm. Cephalothorax light brown, with dark-brown band at base, a little more than half on the first abdominal; longer than broad, wedge shaped, narrowly but squarely truncate at apex; truncation about one-fourth the breadth at the spiracles. Lateral margin slightly convex to spiracles; posterior portion transversely quadrate. Spiracles lateral, but not prominent. Mandibles rounded with acute curved tooth at apex.

Triungulinid: Length of body 0.13 mm., length including stylets 0.18 mm., breadth of head 0.02 mm., greatest breadth 0.03 mm., breadth of ninth abdominal segment 0.018 mm.

The characters are essentially the same as those described for *Stylops californica.*

Type.—Cat. No. 10097, U.S.N.M.

26. STYLOPS SALICIFLORIS, new species.

Host.—*Andrena* (*Trachandrena*) *salicifloris* Cockerell (det. H. L. Viereck); Washington, and Seattle, Washington, on gooseberry. Described from two females (pl. 4, fig 5).

Female.—Length of cephalothorax 1.01 mm., breadth at spiracles 1.04 mm., breadth at base of head 0.64 mm., distance between mandibles 0.14 mm. Cephalothorax light yellowish brown, with slightly convex dark-brown band at base, half on thorax and half on first abdominal; about as long as broad, broad-wedge shape, narrowly truncate; truncation slightly convex, more than one-fourth the breadth at the spiracles. Lateral margin wavy, convex. Mandibles rounded obtuse, with sharp curved tooth at apex. Spiracles lateral, slightly prominent.

Type.—Cat. No. 10098, U.S.N.M.

27. STYLOPS SOLIDULÆ, new species.

Host.—*Andrena solidula* Viereck; collected at Pullman, Washington, by C. V. Piper, and *A. solidula* Viereck (*junonia* Viereck), bearing same date, all determined by H. L. Viereck. Described from one male and three females (pl. 2, figs. 7, 13; pl. 4, fig.6).

Male.—A male pupa was extracted, which furnishes the following characters. Antennæ with third joint not quite attaining tip of sixth; fourth, fifth, and sixth joints subequal, with sixth slightly longer than fifth. The mandibles were not visible; the first joint of the maxillæ seems to be short, the second is elongate flattened, somewhat tapering to the apex and considerably longer than the sixth segment of the antennæ. The œdeagus is of peculiar shape, being bent at about a right angle upward with the lower outside angle acutely produced downward and the outer side almost straight from this angle to the apex; the lower side is broadly and shallowly sinuate; the upper side is broadly rather deeply emarginate in the middle one-third. The adult in its puparium measured 3.25 mm.

Male.—Cephalotheca: Transverse, broadly elliptical, convex, the eyes occupying only a little over one-half of the width. Face divided medianly by the broad arched margin of the vertex, above the center of which is a short transverse reversed ridge. The vertigial margin extends only two-thirds of the distance from the center to each eye. Immediately above the ends of this margin and extending almost to the eyes are the large suboval antennal analogues, which are indicated by several faint concentric rings and a difference of surface. Below the vertigial margin is a transverse arched area bounded below by an indistinct line parallel and equal to the vertigial margin. This strip, which may be a labral or clypeal analogue, has a punctured surface in distinction from the upper part of the pharyngeal area which is distinguished by a mass of closely sinuate lines. The entire pharyngeal area is somewhat keystone-shaped, roughly divided by sculpture into three areas of which the upper has just been described. The median area contains the opening of the pharynx and is laterally deeply emarginate for the reception of the mandibular analogues. These analogues are prominent and sharply defined, and considerably closer to the pharynx than to the eyes; they arise below the ends of the labral analogues and are separated from the antennal analogues by a distance equivalent to the width of that strip. The maxillary are contiguous to the mandibular analogues and slightly closer together on the inner side; they are faintly defined by a large subelliptical area, including a much smaller ellipse. The labial analogue is a narrow marginal strip.

Female.—Length of cephalothorax 1.38 mm., breadth at spiracles 1.26 mm., breadth at base of head 0.70 mm., distance between mandibles 0.19 mm. Cephalothorax brown with darker band at base;

considerably longer than broad, more or less convex on all sides, apically convexly truncate; truncation one-fourth the breadth at the spiracles. Mandibles rounded, obtuse, with acute curved tooth at apex and slightly rounded elevation at middle of outer edge. Spiracles reaching a little beyond lateral margin.

Type.—Cat. No. 10099, U.S.N.M.

28. STYLOPS SPARSIPILOSÆ, new species.

Host.—*Andrena sparsipilosa* Viereck (paratype); Waldoboro, Maine, July 12, 1898. Described from female from the collection of H. L. Viereck (pl. 4, fig. 7).

Female.—Length of cephalothorax 0.72 mm., breadth of spiracles 0.77 mm., breadth at base of head 0.46 mm., distance between mandibles at base 0.10 mm. Cephalothorax light yellowish brown with a darker brown band at base; not as long as broad, squarely truncate at apex; truncation less than one-third the breadth at the spiracles. Lateral margin convex. Mandibles broadly, convexly quadrate. Spiracles lateral but not prominent.

Type.—Cat. No. 10100, U.S.N.M.

29. STYLOPS SUBCANDIDÆ, new species.

Host.—*Andrena subcandida* (det. H. L. Viereck); Southern California. Described from three females and many triungulinids (pl. 4, fig. 8).

Female.—Length of cephalothorax 0.75 mm., breadth at spiracles 0.77 mm., breadth at base of head 0.47 mm., distance between mandibles at base 0.10 mm. Cephalothorax light brownish, with narrow slightly darker band at base, half on thorax and half on abdomen; about as long as broad, truncate at apex; truncation almost one-third the breadth at the spiracles. Lateral margin sinuately convex. Mandibles obtusely rounded, with small acute curved tooth near apex. Spiracles dorsal, just reaching lateral margin.

Triungulinid: Length of body 0.19 mm., length including stylets 0.23 mm., breadth of head 0.04 mm., greatest breadth 0.06 mm., breadth of ninth abdominal segment 0.03 mm.

The characters are essentially the same as those described for *Stylops californica*.

Type.—Cat. No. 10101, U.S.N.M.

30. STYLOPS SWENKI, new species.

Xenos (?), species, PIERCE, 1904, p. 17.

Host.—*Andrena solidaginis* Robertson; Lincoln, Nebraska, September, August 18, 19, 30, 1903. Also collected at Collingdale (Delaware County), Pennsylvania, August 31. Described from three females and multitudes of triungulinids collected at Lincoln by Mr. Swenk and the writer.

Female.—Length of cephalothorax 0.82 mm., breadth of spiracles 0.96 mm., breadth at base of head 0.60 mm., distance between mandibles 0.15 mm. Cephalothorax light yellowish brown, with dark brown band at base; broader than long, subtrapezoidal, squarely truncate at apex; truncation over one-fourth the breadth at the spiracles. Lateral margin very slightly convex. Mandibles rounded with an outward curved tooth at apex. Spiracles slightly prominent at sides.

Triungulinid: Length of body 0.18 mm., length including stylets 0.22 mm., breadth of head 0.03 mm., greatest breadth 0.063 mm., breadth of ninth abdominal segment 0.02 mm.

Proportionate breadths of segments at broadest point:

Head.	Pro.	Meso.	Meta.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
12	14	15	19	21	22	22	21	20	18	16	14	12	8

Proportionate lengths of segments on median line, dorsal:

Head.	Pro.	Meso.	Meta.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
8	8	5	5	3.5	4.5	3	3.5	3	4	2.5	3	4	2

This triungulinid was previously described by the writer with the following characters:

> Head shorter than broad; eyes not prominent, consisting of several little blotches of pigment; antennæ very small, not as long as eyes are wide; mandibles short, acuminate, about as long as eyes, immediately in front of eyes, not meeting at middle; other mouth parts too small to recognize distinctly. Legs short, slender, weak, hardly equaling in length the width of the prothorax; tibiæ terminated by long, almost invisible acuminate pad, which is strongly convex on the edge and almost equals in length the tibiæ. Body enlarging gradually to second abdominal and then narrowing to the last segment, which is squarely truncate and terminated at each side by a short tubercle, bearing a long, stout, acuminate stylet, which equals about six segments of the abdomen. Dorsum armed with many short stout spines at the apical edge of each segment; venter armed with but few spines on each abdominal segment.
>
> Twenty-one hundred and fifty-two of these were actually counted as offspring of one female (Pierce, 1904, 17).

Type.—Cat. No. 10102, U.S.N.M.

Named in honor of the writer's former associate, Myron H. Swenk, who collected some of the specimens, and who has proven himself a diligent worker on the Apoidea (pl. 4, fig. 9).

31. STYLOPS VENTRICOSÆ, new species.

Stylops melittæ NASSONOW, 1893 *a*.

Host.—*Andrena ventricosa* Dours; Europe (recorded definitely from Fiume, Hungary, by Friese, 1893).

Female.—Cephalothorax light yellowish brown with a dark band extending convexly forward to the middle of the disk, but laterally beginning at the spiracles; as long as broad, apically broadly rounded obtuse, laterally very slightly convex. Spiracles dorsal, not reaching lateral margin.

This description is incomplete, as it is drawn from the figure (Nassonow, 1893 *a*, pl. 1, figs. 4, 6).

Triungulinid: This stage is accurately figured by Nassonow (1893 *a*, pl. 1, figs. 8, 9).

32. STYLOPS VICINÆ, new species.

Stylops childreni PACKARD, 1864.

Host.—*Andrena vicina* Smith (det. H. L. Viereck); New Hampshire, C. F. Baker, collector; Canada, C. F. Baker, collector. Described from five females from the Baker collection of the United States National Museum. Packard's specimen was collected at Salem, Massachusetts, June 18, on raspberry, by himself. The parasite was just giving forth its young (pl. 4, fig. 10).

Female.—Length of cephalothorax 1.12 mm., breadth at spiracles 1.13 mm., breadth at base of head 0.64 mm., distance between mandibles at base 0.17 mm. Cephalothorax light brownish with a darker brown transverse band at base; as long as broad, squarely truncate at apex; truncation one-fourth the breadth at the spiracles. Lateral margin irregularly convex, with a prominent tuberculation at the base of the mandibles. Mandibles subquadrate with a large curved tooth at the inner apex, spiracles laterally prominent.

Type.—Cat. No. 10103, U.S.N.M.

33. STYLOPS VIERECKI, new species.

Host.—*Andrena* (*Trachandrena*) *texana profunda* Viereck (det. H. L. Viereck); Fedor, Texas, March 18, 1905; Rev. G. Birkmann, collector. Described from three females (pl. 4, fig. 11).

Female.—Length of cephalothorax 0.82 mm., breadth at spiracles 0.86 mm., breadth at base of head 0.53 mm., distance between mandibles at base 0.12 mm. Cephalothorax light yellowish brown with a dark brown band at base; almost as long as broad, squarely truncate at apex; truncation slightly more than one-third the breadth at spiracles. Head slightly constricted at base of mandibles; edge from this point to spiracles almost straight. Mandibles blunt, subquadrate with out-curved tooth at inner apex and small blunt tooth on outer edge. Spiracles hardly prominent laterally.

Type.—Cat. No. 10104, U.S.N.M.

Named in honor of Mr. H. L. Viereck, who furnished the material containing many of these types.

34. STYLOPS OKLAHOMÆ, new species.

Host.—*Andrena flavoclypeata miserabilis* Cresson; Ardmore, Oklahoma, March 12, 1907, on wild plum; F. C. Bishopp, collector (pl. 4, fig. 3).

Female.—Length of cephalothorax 0.78 mm., breadth at spiracles 0.72 mm., breadth at base of head 0.41 mm., distance between mandibles at base 0.07 mm. Cephalothorax light yellowish brown with dark-brown band at base; longer than broad, wedge shaped, squarely truncate at apex; truncation less than one-third of the breadth at the spiracles. Head slightly constricted at the base of the mandibles, margin slightly wavy. Mandibles rounded quadrate, with out-curved tooth at apex and less prominent tooth at the middle of the outer edge. Spiracles lateral but not prominent.

Type.—Cat. No. 10105, U.S.N.M.

6. Genus PARASTYLOPS Meijere (1908).

Type of genus.—*Parastylops flagellatus* Meijere. The genus is typically Javan, but the hosts are unknown.

Antennæ long, six-jointed, the three first joints short, the third with a very long cylindrical process; the three last flattened, together as long as the process of the third joint. Mandibles long and slender, outwardly arcuate. Maxillæ long, the second joint straight, almost cylindrical, not greatly narrowed at apex. Tarsi four-jointed. Wings very broad, rounded, with seven principal veins, the subcostal and radial united at their apices; two free veins between radius and medius; stigma distinct.[a]

1. PARASTYLOPS FLAGELLATUS Meijere (1908).

Semarang, Java, November 28, 1905; Edw. Jacobson (pl. 2, figs. 1, 2, 3).

The following description is taken from Meijere.

Male.—Head soft blackish brown. Antennæ grayish brown, with the first three joints very short; the three following considerably longer; the fourth somewhat longer than the sixth; the fifth only half as long as the last. Mandibles and maxillæ dark brown. Thorax dark brown; on the sutures brighter, golden brown. Abdomen dark brown. Front femora dark brown; hind femora golden brown with apex darker; front tibiæ golden brown, darker beneath; hind tibiæ brown; knees blackish; tarsi with basal portion of each joint very dark brown, the remainder white. Elytra golden brown, somewhat club shaped. Wings on costal margin gray; veins blackish brown, reaching almost to the margin; costal margin in basal half thick, dark.

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[a] Augen sitzend, mit zahlreichen Facetten. Fühler lang, 6-gliedrig, die 3 ersten Glieder kurz, das 3te mit sehr langen cylindrischen Anhang; die 3 letzten Glieder bandartig abgeflacht, zusammen so lang wie der Anhang des 3ten Gliedes. Mandibel lang und schmal, nach oben gebogen. Taster von derselben Länge, 2-gliedrig, das 2te Glied gerade, fast cylindrisch, nach der Spitze hin sehr wenig verjüngt. Bildung des Metathorax wie in Fig. 8. Tarsen 4-gliedrig. Flügel sehr breit, gerundet, mit 7 Hauptadern, die 2te und 3te an der Spitze verbunden; zwischen der 3ten und 4ten 2 wurzelwärts freie Adern; am Vorderrand ein deutliches Stigma (Meijere, 1908).

Length of body, 1.75 mm.; breadth of head, 0.5 mm.; length of antennæ, 1 mm.; length of elytra, 0.4 mm.; expanse of wings, 3 mm. Œdeagus near apex bent back into an acute process.[a]

7. HALICTOSTYLOPS, new genus.

The genus is parasitic on the Andrenid genus *Halictus* and in the present sense occurs in Europe.

This genus name may be spoken of as a transitional name. That is, it is proposed to contain the species *Halictophagus spencii* Nassonow (1893 *a*) until the proper resting place of that species may be ascertained. The genus will undoubtedly hold its rank because of the great dissimilarity between this species and *Halictoxenos crawfordi.* The location of the genus however is dubious. The female has the aspect of a *Stylops* and yet *Halictoxenos* is a xenid. It would be strange indeed if the parasites of the halictine series should fall part in Stylopidæ and part in Xenidæ.

Female.—Cephalothorax triangular from stigmatal angles, narrowly truncate at apex; mandibles marginal. Stigmata not lateral. Abdomen with five median genital tubes on the second to sixth segments (Nassonow, 1893 *b*).

Triungulinid: Similar in form to that of *Stylops.* Tenth abdominal segment short, triangular, with two ventral tubercles as long as segment and each bearing a long stylet (Nassonow, 1893 *b*).

1. HALICTOSTYLOPS SPENCII Nassonow (1893).

Halictophagus spencii NASSONOW, 1893 *a*.
Halictophagus curtisii NASSONOW 1893 *b*.

The species is parasitic on *Halictus minutus* Kirby, and occurs in England and on the continent of Europe.

This name was given in error, but was accompanied by an illustration, which is technically a description. The genus *Halictophagus* is composed of homopterous parasites, by a strange error in assumption of evidence.

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[a] *Male.*—Kopf matt schwarzbraun, Fühler graubraun, die 3 ersten Glieder sehr kurz, die 3 folgenden bedeutend länger, das 4te Glied etwas länger als das 6te, das 5te nur halb so lang als letzteres. Mandibel und Taster dunkelbraun, Thorax dunkelbraun, an den Nähten und am Rande heller, ins Gelbbraune ziehend. Hinterleib dunkelbraun, desgleichen Bauch und Hypopygium. Vordere Hüften dunkelbraun; Hinterhüften braungelb mit dunkelbrauner Spitze; vorder Schenkel braungelb, unten dunkler, Hinterschenkel braun, Schienen schwarzbraun, die Tarsen oben am Wurzelteil der Glieder schwarzbraun, im Übrigen weiss. Elytren schwarzbraun, etwas keulenformig. Flügel namentlich am Vorderrande etwas graulich, das Geäder schwarzbraun, die Adern fast bis zum rande verlaufend; der Vorderrand an der Wurzelhälfte dick, dunkel; für das Geäder vergleiche man Fig. 10. Körperlänge 1.75 mm., Kopfbreite 0.5 mm., Fühlerlänge 1 mm.; Länge der Elytren 0.4 mm.; Flügelspannung 3 mm. Die Genitalien sind schwer sichtbar, aber der Hauptsache nach wie bei *Halictophagus*, an der Spitze findet sich ein zurückgeschlagener, fast gerader dornförmiger Fortsatz (Meijere, 1908).

From Nassonow's figure of the female the following description may be deduced: Cephalothorax abruptly angled at the metastigmata, thence rapidly narrowed to the apex, with a very short truncation. Head not equal in width to one-third the distance between the metastigmatal angles. Mandibles, obtuse, rounded, and approximate to the edge of the head. Stigmata not visible on the lateral edge. A dark segment of a circle lies ventrally against the posterior edge of the cephalothorax (Nassonow, 1893 *a*, pl. 1, figs. 11, 12).

Triungulinid: The body is elongate, only slightly tapering apically. Head semicircular. Eye patches showing three small lenses ventrally. Thorax only slightly broader than head. Legs four-jointed, (coxa, femur, tibia, tarsus); tarsi long, acute. Abdominal segments, each with a light fringe of hairs. Tenth segment subacute with two ventral tubercles, from each of which arises a long stylet equal to about seven segments of the abdomen.

4. Family HYLECHTHRIDÆ Pierce, 1908.

Hymenopterobiæ (part) SAUNDERS, 1872.
Stylopides (part) SAUNDERS, 1872.

Antennæ five-jointed, with fourth joint very short, and fifth elongate.

The family includes the one genus *Hylechthrus* Saunders, parasitic on *Prosopis* in Europe.

8. Genus HYLECHTHRUS Saunders (1850).

Hylechthrus SAUNDERS, 1872.—PIERCE 1908.

Type of genus.—*Hylechthrus rubi* Saunders, 1850.

Named from *Hylæus* + ἐχθρός (enemy), meaning a parasite of the genus *Hylæus* or *Prosopis*.

The following description is taken from that published by Saunders.

Antennæ 5-jointed; basal joint short; second small, truncate; third laterally produced in a very long flat process; fourth very small, annulate; fifth elongate, similar to the process of the third and resting against that. Maxillæ small, broader than palpi, with apex obliquely truncate; palpi slender, setose.[a]

The remainder of the description given by Saunders is merely of specific value and will be added to the description of *H. rubi*, as it is evidently based on that species, which, as the type of the genus, is the basis of comparison for the other species of the genus and the only one adequately figured.

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[a] Antennæ 5-articulatæ; articulo basali brevi; secundo parvo, truncato; tertio longissimo, spatulato, totâ ferè latitudine subæquali, quartumque basin versùs latere externo ferenti, hoc parvo, annuloso; extimo (5-to) tertio simillimo, et illum recumbenti. Palpi parvi, articulo basali crassior, apice obliquo; apicali graciliori, setoso (Saunders, 1850).

1. HYLECHTHRUS RUBI Saunders (1850).

var. *Hylechthrus rubi pustulatus* SAUNDERS, 1872.
Hylechthrus rubi SAUNDERS, 1852, 1872.—PIERCE, 1908.

Host.—*Prosopis rubicola* Saunders; Epirus, June (fig. 3, nos. 7, 8; pl. 5, figs. 1, 2).

The original description by Saunders is essentially as follows:

Male.—Black, legs luteous, wings milky, veins piceous. Length ½–⅚ lines; wing expanse almost 1½ lines. Head large, transverse. Eyes very large. Thorax anteriorly constricted; disk gibbous, subequal to breadth of head; praescutum very large, elongate-triangular, with anterior margin sinuate, sides straight, with posterior angle subacute, porrect. Elytra small, apically strongly dilated clavate, subconcave. Wings thickened on costal margin to middle, subcosta abbreviated, joined to costa; radius parallel with subcosta, becoming evanescent beyond middle of wings; medius arising from radius at base, straight, deflexed from radius; between radius and medius lie a detached branch of each, the first very strong at base; cubitus not basally attached, slender, attaining external margin; first two anal veins subapproximate, near internal margin, strong at base, third anal almost obliterated. Abdomen strongly constricted. Legs of moderate length, posterior tibiæ dilated, compressed.

Female.—Larviform; cephalothorax flattened, above subconvex, below subconcave, pale, with darker marginal line; with a vitta on each side, two small transverse spots near base, and posterior angles brown.[a]

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[a] *Male.*—Niger, gibbosus; pedibus luteis; alis lacteis; venis saturatè piceis.

Long. corp. ½–⅚ lin. Expans. alar. ferè 1½ lin.

(The remainder is from the original generic description.)

Caput magnum, transversum. Oculi ingentes. Thorax anticè constrictus, disco gibboso capiti latitudine subæquali; scutello maximo; elongato-triangulari; margine antico sinuato, lateribus rectis, angulo postico subacuto porrecto. Pseudelytra parva, apice valdè dilatato crassiori, subconcavo. Alae, costae dimidio basali inspissato, seu potiùs venâ subcostali, abbreviatâ cum costâ quasi conjunctâ, primâ discoidali, prope basin furcatâ, rama antico ejius cum costâ parallelo, ultra medium alae evanescente ramo postico, recto, deflexo; prope apicem alae incrassatio exstat, cujus basis, venaque duplex tenuissima de margine externo sinuatè producta, intra furcam, retrò extendunt: venis reliquis rectis, deflexis; quarum una gracilis, margini externo attingens; duae subapproximatae, margini interno propiores, basi robustiores; altera (?) analis ferè obliterata. Abdomen valdè constrictum. Pedes longitudine mediocres, posteriorum tibiis dilatatis, compressis, genubus constrictis, tarsorum articulis quatuor, apicali integro.

Female.—Vermiformis; cephalothoracem complanatum, suprà subconvexum, infrà subconcavum, e dorso apis educantis tantum modo protrudens; vaginae aditû, olim clauso, post coitum, sat amplè patenti. Nuper declarata, cephalothorace pallido, lineolâ marginali tenuissimâ nigricanti; vittâ utrinque, maculis binis parvis transversis prope basin, angulisque posticis, brunneis; parturientes autem disco convexiori, ferè omnimò flavescenti, vittâ mediâ longitudinali dilutiori (Saunders, 1850).

The host of this species, *Prosopis rubicola* Saunders, occurs in Epirus. It makes its own nests as a rule, in briars, although sometimes they have been found to build in the unoccupied excavations of *Osmia*, and even in the mud cells of *Odynerus*, and in the same excavations as *Cemonus unicolor*. When parasitized by male *Hylechthrus* this species has the abdomen much lighter, so much so that Saunders described this variation as *Prosopis* (*Hylaeus*) *versicolor*.

2. HYLECHTHRUS QUERCUS Saunders (1850).

Hylechthrus quercus SAUNDERS, 1852, 1872.—PIERCE, 1808.

Host.—*Prosopis gibba* Saunders; Epirus, May, June.

Saunders described this specie essentially as follows:

Male differs from *Hylechthrus rubi* by its greater size, by the wings being more obscured, and the veins much darker. Length ⅔-1 line; expanse of wings about 1¾ line.[a]

Prosopis gibba, the host of this species, dwells in vacant cynipid oak galls, and also in briars in diagonal series. (This last note is based on a marginal note by Saunders in the separate possessed by the author.)

3. HYLECHTHRUS SIEBOLDII Saunders (1852).

Hylechthrus sieboldii SAUNDERS, 1872.—PIERCE, 1908.

Host.—*Prosopis variegata* Fabricius, Epirus, June.

The cephalothorax of the female of this species is distinguished by a broad yellow longitudinal band dilated toward the apex, and by a dark transverse line at the base, interrupted by the passage to the abdominal region.

5. Family XENIDÆ Semenov, 1902; redefined Pierce, 1908.

Strepsiptera or *Stylopidæ* (part) HOEVEN, 1850.
Xenides (part) SAUNDERS, 1872.
Pseudoxenides (part) SAUNDERS, 1872.
Stylopinæ (part) PERKINS, 1905.
Xenini PERKINS, 1906 in correspondence (a tribe of Stylopinæ).

Type genus.—*Xenos* Rossi (1794).

Parasites of Hymenoptera.

Antennæ four-jointed, the third laterally produced; tarsi four-jointed.

The family is composed of four subfamilies:

Xeninæ Pierce, parasitic on Vespoidea and perhaps Sphecoidea.

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[a] *Male.*—Differt (from *Hylechthrus rubi*) magnitudine duplò majori, alis parùm obscurioribus, venisque magis nigricantibus.

Long. corps, ⅔-1 lin. Expans. alar. ferè 1¾ lin.

Individua mutilata tantum vidi (Saunders, 1850).

Homilopinæ Pierce, parasitic on Sphecoidea.
Halictoxeninæ Pierce, parasitic on Apoidea.
Crawfordinæ Pierce, parasitic on Apoidea.

1. Subfamily XENINÆ Pierce, 1908.

Type genus.—*Xenos* Rossi (1794).

Parasitic on Vespoidea and possibly Sphecoidea.

Maxillæ two-jointed.

The subfamily is composed of four tribes:

Xenini Pierce, parasitic on Vespidæ; Europe, America, Asia.
Pseudoxenini Pierce, parasitic on Eumenidae; Europe, America.
Paraxenini Pierce, parasitic on Bembecidæ; Europe.
Ophthalmochlini Pierce, parasitic on Sphecidæ; America.

1. XENINI, new tribe.

Xenides SAUNDERS, 1872.
Xenini PERKINS, 1906, in correspondence.

Type-genus.—*Xenos* Rossi (1790).

Parasites of Vespidæ.

The tribe includes four genera:

9. *Xenos* Rossi (1790), parasitic on *Polistes;* Europe.
10. *Acroschismus* Pierce (1908), parasitic on *Polistes;* America.
11. *Schistosiphon* Pierce (1908), parasitic on *Polistes;* America.
12. *Vespaexenos* Pierce, parasitic on *Vespa;* Asia.

9. Genus XENOS Rossi (1790), redefined.

Ichneumon ROSSI, 1793.
Xenos KIRBY, 1813.—HOEVEN, 1850.—SAUNDERS, 1872.—PIERCE, 1908.
Xenus RYE, 1875.—CENTURY DICTIONARY, 1897.—STILES, 1905.

Type of genus.—*Xenos vesparum* Rossi (1790).

Name derived from ξένος (strange) or ξεῖνος (a guest).

Male.—Antennæ four-jointed, the third produced laterally, third and fourth tapering; tarsi four-jointed; wings having eight primary veins from base, with two distal unattached veins between the radius and medius.

Female.—Cephalothorax rounded, broadly at sides, narrowly in front. Abdomen with four median genital tubes, on the second to fifth segments. Head short at middle, longer at sides; mouth about middle of ventral side, with mandibles on each side, about half way to lateral margins. This brief description is derived from Nassonow's excellent plate of *Xenos vesparum* (Nassonow, 1892 *c*, pl. 1, figs. 1, 4, 9, 14).

Triungulinid: Robust, broadest at mesothorax. Base of head broader than contiguous portion of prothorax. Tarsus of first two pairs of legs rounded pad like, of third pair long, acute. Ninth lateral segments greatly surpassing ninth ventral and bearing a spine on the outer apical angle. Tenth ventral elongate subtriangular, equal in length to about four segments, apically cleft, with a long stylet on each apical point.

The genus contains but two typical species:

1. *vesparum* Rossi (1790), parasitic on *Polistes gallicus;* Italy.
2. *jurinei* Saunders (1872), parasitic on *Polistes gallicus;* Switzerland.

The two species may be identical, but by description are separated as follows:

1. Maxillæ with joints unequal, the first short, rounded, second elongate. *vesparum* Rossi.
   Maxillæ with joints subequal, the last subulate................*jurinei* Saunders.

1. XENOS VESPARUM Rossi (1790).

Ichneumon vesparum ROSSI, 1793.
Xenos vesparum SIEBOLD, 1843.—PIERCE, 1908.
Xenos rossii KIRBY, 1813.—SAUNDERS, 1872.—NASSONOW, 1892 *c, e*.

Host.—*Polistes gallicus* Linnæus; Europe (Italy) (fig. 2, nos. 15, 16, 17; pl. 5, fig. 4; pl. 7, figs. 4, 8, 13).

The original description by Saunders was essentially as follows:

Male.—Black, fuliginous. Head small. Eyes strongly prominent, spherical, composite. Maxillæ short, rounded, with palpus elongate, compressed. Antennæ short, hardly longer than head, third joint branched, the branch equalling the elongate fourth, both of which are deflexed, compressed, somewhat ensiform. Prothorax and mesothorax cylindrical, neck like; metathorax broader, convex, posteriorly greatly elongate. Abdomen almost cylindrical. Femora and tibiæ posteriorly depressed and short. Tarsi fuscous, beneath white. Wings white, as long as the abdomen.[a]

Kirby (1813) has made a humorous statement. He asks pardon for "altering the trivial names" given by Rossi and Peck to these species as they would lead to confusion, and because "a species should not be named from a habitat which is common to several or to a genus." Now it happens that Kirby described *Stylops melittæ*, which name is as general as *vesparum* or *vespæ*. The writer replaces *vesparum*, as according to his interpretation it is a legitimate name. He permits *vespæ* to become a synonym of *Schistosiphon peckii* Kirby, because it was merely a manuscript name (Stiles, 1905, p. 45).

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[a] *Male.*—Totus ater, fuliginosus. Caput parvum. Oculi valde prominuli, sphærici, manifeste compositi. Palpi duo filiformes longiusculi, articulis duobus inæqualibus, primo brevi, rotundo, altero elongato, compresso. Antennæ breves, vix capite longiores, duplici ramo instructæ, ramis æqualibus, deflexis, compressis, quasi ensiformibus. Thorax lobo antico in collum veluti protractus, et singulariter utrinque ad basin appendiculatus, membranula, seu pedunculo instar halterum porrecto, cochleariformi (elytris); in medio latior, convexus, inæqualis, posticeque admodum elongatus. Abdomen fere cylindricum, neque petiolatum neque aculeatum. Femora tibiæque postice depressæ et breviores. Tarsi (articulis) quatuor, fusci, subtus albidi. Alæ albæ, longitudine abdominis (Saunders, 1872).

Female.—The principal character of the species is the mandible. This appendage is very broad at base, with two lobes, to the outer of which one set of muscles is attached. At the middle of the concave base another set of muscles is attached. The forward or outer angle is toothed, acute, the inner angle is lower and rounded.

The following description by Nassonow is taken from a translation in manuscript in the library of the Bureau of Entomology:

> Triungulinid: Size never more than 0.25 mm. in length. Body ventrally flattened, dorsally convex, narrowed at ends and widened at middle. Color, bright cinnamon; with side of head at eyes and sides of last abdominal segment black. Head somewhat triangular, with rounded angles. Five simple eyes at lateral angles. Antennæ and sutures absent. Head above hard, chitinous; below soft, transparent and provided anteriad with two small bristle-bearing protuberances. Mouth parts very incompletely developed. Mouth opening above bounded by the border of the upper wall of the skull and below by a strip which passes over without definite limits into the lower wall of the skull. Thus differentiated upper and lower lips are absent. The only pair of mouth appendages corresponds most probably to the mandibles. These appendages are seen outside only through the thin and transparent wall of the lower part of the head and have the appearance of sticks bent toward the longitudinal axis of the body. The thorax consists of three distinctly delineated segments and is slightly narrowed toward the front. These segments are longer than the abdominal. The dorsal segments bear figures of the shape of three or four transverse rows of quadrangles of irregular outline. These dorsal sclerites bear each a pair of bristles near the posterior margin. The pronotum is also armed with a pair near the anterior margin. The ventral sclerites are but slightly convex at the middle, and on the sides at the posterior margin of the convexity of each segment is attached a pair of legs. Between the bases of the legs are regular rows of bristles. The basal member of each leg is strongly widened and is so joined with the thorax as to be slightly movable. Its opening for the reception of the femur is very large and is directed obliquely forward. On its anterior margin it bears a more or less obtuse tooth near which are situated three round bristles with a ring-shaped shaft at the base. Femur basally enlarged, joined by very free, movable articulation with preceding joint. Tibia straight, narrow, bispinose. Tarsus merely a pulvillus. Abdomen consisting of ten distinct segments, the first eight of nearly equal length and gradually narrower posteriorly. Dorsal sclerites armed near sides of apical margin with spine. The ninth dorsal longer than preceding; posterior margin with semilunar excavation; near sides of posterior margin armed with spine. Ninth ventral apically bearing two conical bristle-tipped appendages. Last segment very narrow apically; posteriorly bearing very long styloid processes; dorsally near sides of apical margin with bristles (Nassonow, 1892 *e*).

2. XENOS JURINEI Saunders (1872).

Xenos vesparum JURINE 1818, 1832, not ROSSI.
Xenos rossii jurinei SAUNDERS, 1872.

Host.—*Polistes gallicus* Linnæus; Geneva, Switzerland (pl. 5, fig. 3).

The following description is abbreviated from the original description by Jurine.

Male.—Head flattened in front. Mandibles long, yellowish, slightly arcuate, crossing in front of mouth. Maxillæ pubescent, subequal with the palpi, which latter are subulate. Eyes large, oval, very prominent, many faceted. Antennæ with third joint laterally produced, the flabellum flat, surface granular. Front terminated by a short sharp process. Thorax very elongate, blackish; prothorax and mesothorax a narrow collar; mesothorax longer; the segments separated by a white membranous connective membrane. Wings very large. Abdomen tawny, short, oval. Legs tawny.[a]

10. Genus ACROSCHISMUS Pierce (1908).

Acroschismus PIERCE.—(DURY, 1906, *b*, *c*).

Type of genus.—*Acroschismus hubbardi* Pierce.

Name derived from ἄκρον, apex +σχισμός, cleavage = apical cleavage, referring to the apical cleavage of the ninth abdominal segment.

This genus seems to be the predominant xenid genus in North America. Species of *Polistes* are the hosts.

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[a] La tête du Xenos est aplatie par-devant. La bouche a deux lèvres, une supérieure, large et ciliée, une inferieure, beaucoup plus petite; près de la supérieure sont implantées deux longues mandibules cornées, jaunâtres, légèrement arquèes sans dentelures, et qui, dans l'etat de repos, se croisent par leur extrémité devant la bouche. Au-dessous des mandibles se trouvent deux longs barbillons formés l'un et l'autre de deux anneaux un peu velus, d'égale longeur, le dernier subulé. Aux parties latérales de la tête sont placés deux grands yeux ovales, très-saillants, et taillés à facettes nombreuses, les petites yeux lisses manquent. Au milieu du front sont implantées les antennes dont la configuration est remarquable; chacune d'elles est composée d'un autre fourchu, ou divisé en deux parties alongées, un peu recourbées et comprimées à-peu-près comme une lame d'épée, à surface granduleuse. Le front se termine par une languette pointu et courte. Le corselet se trouve plus alongé que celui des mouches a quatre ailes. On peut le diviser en trois parties. La première, qui est la plus petite, constitue une espèce de large cou au bout duquel est implantée la tête. De chaque coté de ce cou sort un long appendice, en forme de balancier, d'une structure vraiment, particulière. Il est composée d'un anneau court (prothorax), sur lequel se meut un autre (mesothorax) long anneau, qu'on peu regarder comme la tige de balancier, laquelle est divisée, selon se longeur, en deux parties bien distinctes savoir, l'anterieure qui est ronde, solide, cornée et noirâtre, tandis que la postérieure est faite d'une légère membrane blanche (connective membrane). Au bout de cette tige se trouve la tête du balancier ou le maillet, dont le milieu est creusé en gouttière et le devant un peu échancré. La seconde partie du corselet (metathorax) est divisée en quatre lobes par autant de sillons; il y en a un anterieur (præscutum), un posterior (scutellum) et deux latéraux (lumbi of scutum). De dessous ces derniers sortent deus ailes conformées d'une manière très-remarquable. Elles sont fort grandes et beaucoup plus amples que celles d'aucun diptère; elles n'ont ni nervures, ni cellules apparentes. La partie postérieure du corselet est formée de trois prolongemens particuliers, un superieur (postscutellum; the postlumbium is omitted in his descriptions), qui s'etend, en guise d'ecusson pointu, jusqu'à la base du ventre, et deux latéreaux (femoralia) qui, apres s'être portés en arrière, se contournent sur aux-mêmes en s'inclinant du côté de l'abdomen, et offrent encore une conformation toute particulière. Le ventre du *Xenos* à, comme les pattes, une couleur bistrée; il est court, ovale, pétiolé, et composé de sept anneaux marqués en dessus de deux tâches plus foncées. Ce ventre, comme celui des diptères, s'affaise et se déforme par l'exsiccation. Les pattes sont divisée en quatre parties, savoir, le trochanter, le cuisse, le jambe et le tarse formé de cinq articles, dont le dernier est dépourvu de crochets (Jurine, 1818).

Male.—Typically xenid in the possession of four-jointed antennæ, four-jointed tarsi, and two-jointed maxillæ. Species of this genus differ from *Schistosiphon* (*Xenos*) *peckii* Kirby in the cleavage of the ninth segment of the abdomen to form two claws, between which the reflexed œdeagus arises, and in having the tip of the œdeagus simple, not cleft, with the genital pore before the apex. A characteristic of the genus is the presence of the mesostigmatal lobe on the mesothorax.

Female.—Cephalothorax not as a rule abruptly narrowed behind the stigmatal angle, elongate trapezoidal, obtuse or truncate at apex. Stigmata seldom laterally prominent. Mouth ventral with mandibles on each side, rather broad and obtuse. Abdomen with four median genital canals on second to fifth segments.

Triungulinid: Body oblong, slightly narrowing posteriad. First eight segments normal, ninth greatly elongate, deeply emarginate for tenth, which is elongate and terminated by two stylet bearing lobes, contiguous at base.

The genus contains the following species:

1. *hubbardi* Pierce, parasitic on *Polistes crinitus* (*americanus*); Florida.
2. *bruesi* Pierce, parasitic on *P. metricus;* Michigan.
3. *nigrescens* Brues (1903), parasitic on *P. rubiginosus;* Texas, Louisiana.
4. *pallidus* Brues (1903), parasitic on *P. annularis;* Texas, District of Columbia, Florida.
5. *pecosensis* Pierce, parasitic on *P. texanus, rubiginosus;* Texas.
6. *wheeleri* Pierce, parasitic on *P. metricus;* Connecticut, District of Columbia.
7. *bowditchi* Pierce, parasitic on *P. pallipes;* Massachusetts, Ohio.
8. *hunteri* Pierce, parasitic on *P.* new species, near *minor;* Texas.
9. *texani* Pierce, parasitic on *P. texanus;* Texas.
10. *rubiginosi* Pierce, parasitic on *P. rubiginosus;* Louisiana.
11. *maximus* Pierce, parasitic on *P. rubiginosus;* Texas.

Key of males.

1.	Wing venation pale except at costal margin	2.
	Wing venation dark and distinct throughout	7.
2.	Palpus indistinctly separated from maxilla	*nigrescens.*
	Palpus distinctly separated	3.
3.	Second antennal joint set very deeply in first	*hubbardi.*
	Second antennal joint not set very deeply into first	4.
4.	Apex of œdeagus turned upward almost at a right angle	5.
	Apex of œdeagus turned upward at an acute angle	6.
5.	Palpus considerably shorter than maxilla	*hunteri.*
	Palpus about equal to maxilla	*bruesi.*
6.	Radius of wings not interrupted at node	*pallidus.*
	Radius of wings interrupted at node	*pallidus texensis.*

7. Palpus arising from truncate tip of maxilla .... 8.
   Palpus arising some distance before tip of maxilla .... *pecosensis.*
8. Subcosta and radius black, other veins brown; œdeagus at widest point abruptly rounded above .... *wheeleri.*
   All veins colored black; œdeagus at widest point rounded from rectangle. *bowditchi.*

Key of females.

A table based on the mandibles would be very hard to use, so the following table, based on comparative measurements of the various dimensions of the cephalothorax, is presented. The specimens studied were mounted in balsam.

The measurements are with a Zeiss stand, tube length 160, eyepiece 2, objective A, with eyepiece micrometer (1 space = 0.0076 mm.). As the comparative dimensions are the sought-for characters, other microscopes will be just as available. The actual size of each specimen may be found with its description.

The following measurements were taken: (1) Length from base of cephalothorax to apex; (2) length from line between apices of spiracles to apex; (3) shortest distance between mandibles; (4) breadth of head at base; (5) breadth of cephalothorax at spiracles; (6) greatest breadth of cephalothorax. On account of the larger size of these insects a lower power of microscope was used than in Stylops.

Species.	1. Length.	2. Spiracle to apex.	3. Breadth between mandibles.	4. Breadth of head.	5. Breadth at spiracles.	6. Greatest breadth.
maximus	225	145	43	195	240	260
pecosensis	233	148	47	180	225	230
	207	127	38	178	220	220
	207	127	44	180	225	225
rubiginosi	220	160	40	155	210	222
hubbardi	212	138	31	145	183	189
texani	210	140	36	140	205	205
pallidus	194	124	31	124	172	178
bruesi	195	118	43	170	213	216
	186	111	37	148	185	187
hunteri	170	110	29	127	160	164
wheeleri	170	110	35	137	168	174
nigrescens	170	100	38	128	168	172
bowditchi	136	76	38	148	185	189

Following is a comparison of dimensions by ratio. The first column represents the ratio of the breadth of the cephalothorax between the spiracles to the distance between the mandibles; the second represents the ratio of the breadth of the head to the distance between the mandibles; the third the ratio of the breadth between the spiracles to the breadth of the head; and the fourth the ratio of the breadth between the spiracles to the distance from spiracles to apex. The third and fourth are of greatest impòrtance.

Species.	Cephalothorax to mandibles. (5) : (3) : :—: 1.	Head to mandibles. (4) : (3) : :—: 1.	Cephalothorax to head. (5) : (4) : :—: 1.	Breadth to length. (5) : (2) : :—: 1.
maximus	5.58	4.53	1.23	1.65
pecosensis	4.78-5.78	3.83-4.68	1.23-1.25	1.52-1.77
rubiginosi	5.25	3.87	1.35	1.31
hubbardi	5.90	4.67	1.26	1.32
texani	5.69	3.88	1.46	1.32
pallidus	5.54	4.00	1.38	1.38
bruesi	4.95-5.00	3.95-4.00	1.25	1.66-1.80
hunteri	5.52	4.37	1.25	1.45
wheeleri	4.80	4.60	1.22	1.52
nigrescens	4.42	3.36	1.31	1.68
bowditchi	4.87	3.84	1.25	2.43

1. ACROSCHISMUS HUBBARDI Pierce (1908).

Xenos, species Hubbard, 1892.
Xenos hubbardi Pierce, in determinations.

Host.—*Polistes* (*americanus* Fabricius) *crinitus* Felt; Crescent City, Florida, April 6. Described from fourteen males in the collection of the U. S. National Museum, collected by H. G. Hubbard (Hubbard, 21). It is upon these specimens that Hubbard based his valuable observations on the life history of *Xenos* (pl. 6, figs. 1–12; pl. 9, fig. 3).

Male.—Wing expanse 5.5 mm., length 2–3 mm. The specimens measured, respectively, 2, 2, 2, 2.25, 2.5, 2.5, 2.5, 2.5, 2.75, 3, 3, 3, 3 mm.

The following description was published by the present author in 1908:

> Color, brown. Antennæ apparently brown, but on closer inspection transparent yellow with blackish brown pubescence; first joint yellow. Face fulvous, pubescent; mandibles transparent yellowish, glabrous. Vertex dark, head brown, eyes black. Prothorax and mesothorax dark with elytra yellowish, pubescent, darker at club. Metathorax lighter, brownish, with exception of postscutellum, which is dark brown. Wings milky white, hyaline, irridescent, with dark brown costal margin; veining delicate yellowish brown, pubescent gray; last three veins very light. Legs yellowish. Abdomen yellow with black borders (Pierce, 1908).

Antennæ a little shorter than width of head, very sensitive pubescent; the first with a veil-like curtain extending beyond and enveloping the entire second joint, but so transparent that the second joint is easily made out when viewed with a microscope. Maxillæ yellow, two-jointed, with the first joint longest and somewhat obliquely truncate (the second joint is the palpus). Mandibles acute, somewhat curved, ensiform, about twice as long as maxillæ. Eyes stalked. Prothorax and mesothorax about equal in length, each about one-half as long as wide. Mesothorax with apical angles produced obliquely backward. Elytra a little longer than the width of the mesothorax, ladle-form with the hollow of the spoon ventral, much wrinkled. Under a compound miscroscope a small hook is discernible beneath the base of each elytron and apparently attached thereto. In diameter it is about one-quarter the width of the elytron. Below this is the very delicate hairy mesostigmatal lobe belonging to the mesosternum and broadly attached to the second quarter of the lateral edge. The lobe presents a broadly convex surface to the hook, but ventrally shows a folding parallel with its edge, which creates a channel leading back to the base, where it is narrowed by an anterior lobe and a posterior acute ridge, which form the guardians to the almost circular orifice of the mesostigma. The lobe is about once and a half as long as the basal width of the elytron. Metathorax with praescutum keystone shape; scuti about twice as long as wide, almost meeting behind the praescutum, at which point they are laterally broadest; scutellum triangular; postlumbium transverse, short; femoralia linear, long; postscutellum broadest near its base, rounded at the apex, over twice as long as broad at broadest point. Wings with seven primary veins, arising at the base. The radius is interrupted at the node, beyond which interruption it immediately forms an open loup and continues in the original direction. A short vein occurs between this and the medius and another between the medius and cubitus. Prosternum narrow, band-like, hardly one-fourth as long as the mesosternum. Coxæ transverse, not contiguous, apparently open behind; trochanters elongate subcylindrical, over twice as long as coxæ; femora elongate, slender, nearly twice as long as trochanters and slightly curved; tibiæ elongate, slender, equaling femora; tarsi four-jointed, first three joints subequal, obliquely truncate and cup-shaped at apex for reception of the following, ventrally and laterally produced into velvety underlapping pulvilli; last tarsal joint as long as the three preceding (to its own base), forming a very delicate enlarged conical cup with the apex obliquely truncate from near the middle of dorsum. The pulvilliform parts of the tarsi are thickly matted with sharp hairs. Mesosternum broader than long; coxæ apical, open behind, contiguous on inner edges, transverse; trochanters longitudinal, contiguous on inner edges, sinuately curved on outer edges, femora equaling trochanters plus coxæ, inflated at basal third, narrowed beyond apical third; tibiæ subequal to femora; tarsi as on anterior legs. Metasternum elongate; legs apical; coxæ contiguous, cylindrical, length and breadth subequal, cupped for the reception of the trochanters; trochanters flaring toward apex, longer than broad, obliquely cupped for the reception of the femora, femora at base equaling base of trochanters in diameter, inflated and obtusely bent at basal third, longer than the two preceding joints; tibiæ not attaining the bend of the femora when folded, narrowest just beyond base, gradually flared toward apex; tarsi equaling tibiæ, and similar to preceding pairs. Genitalia with the ninth ventral segment apparently uncovered, and apically cleft, forming two lobes, from between which the siphonated oedeagus arises. "Œdeagus reflexed and apically protected by the overhanging tenth segment. The genital pore through which the slender penis finds exit is situated at the basal one-third of the upturned tip of the oedeagus on the inner angle" (Pierce, 1908).

Female.—Length of cephalothorax 1.61 mm., breadth at spiracles 1.39 mm., breadth at base of head 1.10 mm., distance between mandibles at base 0.23 mm. Cephalothorax light brownish, lighter at apex; longer than broad, elongate subquadrate, slightly oblique at sides; broadly, convexly truncate at apex, truncation more than one-half the breadth at the spiracles; lateral margin sinuate with three depressions, the last in front of the spiracles; spiracles not laterally prominent; mandibles distant from lateral margins of head, subquadrate with inner angle receding and armed with an outward curved tooth.

Triungulinid: Length of body 0.22 mm., length including stylets 0.30 mm., breadth of head 0.06 mm., greatest breadth 0.07 mm., breadth of ninth abdominal segment 0.04 mm. First eight segments normal, ninth elongate, deeply emarginate for the tenth, which is elongate and terminated by two stylet-bearing lobes, contiguous at base.

Type.—Cat. No. 9825 U.S.N.M. Cotype in collection of Charles Dury at Cincinnati, Ohio.

2. ACROSCHISMUS BRUESI, new species.

Xenos bruesi Pierce in determinations.

Host.—*Polistes metricus* Say. (det. W. H. Ashmead); Detroit, Michigan; two specimens of male, several females (pl. 5, figs. 7, 10, 11; pl. 9, fig. 2).

Named in honor of Mr. C. T. Brues, of Milwaukee, Wisconsin.

Male.—Length 3.5–4 mm., antennæ 1.25 mm. Reddish brown: antennæ brownish, cheeks black, front lighter, mouth parts fulvous, eyes black. Scuti reddish brown, scutellum blackish, postlumbium very light, postcutellum brown, lightening toward apex. Abdomen and legs fulvous; oedeagus glabrous, yellow; and claws yellow, pubescent. Wings milky, with clear-white pubescence. Antennæ long, equaling width of head, first joint obliquely truncated, second very small, fourth joint surpassing third. Maxillæ with first joint short, palpus narrowed at base and once and a half as long as preceding joint. Mandibles about twice the length of second maxillary joint (palpus), and not capable of reaching eyes. Thoracic structure similar to that of *A. hubbardi*. The writer was, however, unable to detect the mesostigmatal lobes described for that species, but thinks they are present. Genitalia similar with the exception that the oedeagus is more abruptly curved, is obliquely depressed to the second turn, and thence is much narrowed and very acute to the apex.

Female.—Length of cephalothorax 1.41–1.48 mm., breadth at spiracles 1.40–1.61 mm., breadth at base of head 1.12–1.29 mm., distance between mandibles at base 0.28–0.32 mm. Cephalothorax light brown with very little color variation; as broad or broader than long, laterally convex to spiracles, thence straight to point opposite base of mandibles, apically very convex; spiracles not laterally prominent; mandibles distant from lateral margins of head, quadrate; inner angle armed with a large outward curving tooth.

Type.—Cat. No. 9826, U.S.N.M.; Hubbard and Schwarz collection.

3. ACROSCHISMUS NIGRESCENS Brues (1903).

Xenos nigrescens Brues, 1903, 1905.
Acroschismus nigrescens Pierce, 1908.

Host.—*Polistes rubiginosus* Lepeletier; Austin, Texas (males, female). *P. rubiginosus* and *P. annularis* (?) (males, females); Paris, Texas (Brues, 1905).

The original description by Brues is as follows:

> *Male.*—Length 4.5 mm. Black above, abdomen often gray at base, head above piceous, antennæ dark cinereous. Mandibles black at base, lighter at tips. Palpi cinereous, indistinctly two-jointed, the second joint one-half as long as, and connate with, the first ventrally, where no suture is visible; above it appears indistinctly constricted off from the first. Prothorax black or piceous above, somewhat lighter on the sides; elytra cinereous. Dorsum of thorax fuscopiceous, lighter on the sides and at tip of post-scutellum. Abdomen usually black, sometimes gray at base and with two indistinct longitudinal dark bands. Wings delicate, pale hyaline, much as in (*X.*) *pallidus* except that the subcostal nervure (=third, or radial) is interrupted near the middle (node) as in *X. peckii* (=*Acroschismus wheeleri* Pierce); all the posterior veins nearly obsolete. Body below in great part piceous, abdomen black or gray below. Legs cinereous, darker above on femora, tibiæ, and tarsi.
>
> *Female.*—Length 9–10 mm. Exposed surface of head (=cephalothorax) black on posterior two-thirds, orange on anterior one-third, the line dividing the two colors straight transverse. Anterior half of thorax (=basal segments of abdomen) yellow, its lateral wrinkles ferruginous. Dorsal (sic, =ventral morphologically, although uppermost) stripe of abdomen (=area of brood canal) brownish, nearly half as wide as the body, at base narrowed and faded out posteriorly. Genital pores on median line near posterior margin, distinct.
>
> Described from one female and four male specimens, collected and bred at Austin, Texas, during October, 1901 (Brues, 1903).
>
> Triungulinid: Length 0.28 mm. Oval, head obtusely rounded, anteriorly. Head and thorax together slightly longer than the abdomen. Head a little less than half as long as the thorax, almost semicircular when seen from above, being truncate behind. Eyes large, strongly pigmented. Oral opening large, almost contiguous with the eyes below; mouth parts consisting apparently of a short proboscis-like organ with chitinous sides. No antennæ or other tactile organs to be seen. Thorax one and one-half times as long as wide, consisting of three nearly equal transverse seg-

ments. Each segment below bears a pair of very small and delicate legs. The coxæ are all greatly swollen and globose, those of each side contiguous with one another and the pairs only moderately separated along the median line. Each coxa is hollowed out below and the trochanter sunk within it. Femora slender, enlarged somewhat at base, bearing a spine apically. Tibiæ slender, of equal width, the hind ones with a preapical spine. Tarsi greatly reduced, those of the four anterior legs scarcely distinguishable from the tips of the tibiæ furnished with a pulvilliform appendage, the posterior pair elongated, with a styliform appendage. Abdomen consisting of nine short, transverse segments and an elongated tenth segment which encloses the extrusible tip of the abdomen (eleventh segment?). The dorsal sclerites reach far down on the sides, as do also those of the thorax, making the underside of the body somewhat concave. Tip bearing two approximated bristles, each as long as the abdomen, in addition to a much shorter one at each lateral angle of the last segment (Brues, 1905).

Brues's figure of the triungulinid is evidently in error, as it is given fourteen abdominal segments.

Female.—The following description is drawn from the type specimens:

Length of cephalothorax 1.49 mm., breadth at spiracles 1.27 mm., breadth at base of head 0.97 mm., distance between mandibles at base 0.28 mm. Cephalothorax light brownish, darker on basal two-thirds except on center of disc; deeply emarginate at base, oblique, convex to point opposite base of mandibles, apex very convex; spiracles not laterally prominent; mandibles distant from lateral margins of head, oblique, oblong, with outward curved tooth on inner angle and outer angle prominent rounded.

4. ACROSCHISMUS PALLIDUS Brues (1903).

Xenos pallidus Brues, 1903, 1905.
Acroschismus pallidus Pierce, 1908.

Host.—*Polistes annularis* Linnæus; Austin, Texas (Brues, 1903); Paris, Texas (Brues, 1905).

Brues originally described this species as follows:

Male.—Length 2.25 mm. Head and thorax above fuscous, below, very pale luteous, antennæ with the first two joints luteous, the rami of the fourth joint (third and fourth joints) yellowish gray, their spots pale. Eyes black, their hemispherical facets of the usual size. Mandibles pale luteous, white at tip. Palpi white, distinctly two-jointed, the first joint nearly twice as long as the second and obliquely truncate at apex; second joint oval. Prothorax and mesothorax fuscous; elytra pale, grayish at tip. Dorsal sclerites of the metathorax shaped as in *X. peckii* (=*Acroschismus wheeleri* Pierce); fuscous, darker on the post-scutellum. Legs pale luteous, tarsi slightly grayish above near tips. Wings pale hyaline, the nervures very delicate and not pigmented along their edges. The costal margin darkened for nearly its entire length. Abdomen finely transversely wrinkled on the dorsal surface; grayish yellow, blackened above, especially posteriorly. Ventral plates honey yellow, hypopygium (ninth segment) yellow except the dorsal piece (tenth segment), which is grayish.

Described from 24 male specimens, all bred from individuals of *Polistes annularis* Linnæus, at Austin, Texas, during May (Brues, 1903).

Female.—The following description is drawn from the typical material:

Length of cephalothorax 1.47 mm., breadth at spiracles 1.30 mm., breadth at base of head 0.94 mm., distance between mandibles at base 0.28 mm. Cephalothorax dark brown except in front of line between posterior lateral corners of head, which portion is much lighter; considerably longer than broad, very slightly constricted at base, convex from base to spiracles, thence oblique and almost straight to base of head, thence unevenly sinuate; apex truncate, sinuate; spiracles not laterally prominent; mandibles distant from lateral margins of head, oblique, oblong, with outward curved tooth on inner margin.

ACROSCHISMUS PALLIDUS TEXENSIS, new variety.

Material collected at Rosser, Texas, in August, 1905, by F. C. Bishopp and C. R. Jones from *Polistes annularis* has been called *Acroschismus pallidus* by the writer, but a careful comparison of the descriptions of *A. pallidus* and *A. nigrescens* indicates a varietal tendency; hence the convenience name *texensis* (fig. 3, nos. 9, 10; pl. 7, figs. 1, 5, 9; pl. 8, figs. 2, 3; pl. 9, figs. 5, 6).

Male.—Size: *texensis*, specimens measure respectively 2.6, 2.8, 2.8, 3, 3, 3, 3, 3, 3, 3.1, 3.2, 3.2, 3.3, 3.4, 3.5 mm.; i. e., 2.6–3.5 mm.; *pallidus*, 2.25–2.75 mm. (Brues); *nigrescens*, 4.5 mm. (Brues). Antennæ: *texensis*, first joints pale, third and fourth darker; *pallidus*, first joints pale, third and fourth darker (Brues); *nigrescens*, dark cinereous (Brues). Mandibles: *texensis*, entirely pale yellow; *pallidus*, pale luteous to white (Brues); *nigrescens*, black to lighter (Brues). Maxillæ: *texensis*, distinctly jointed, pale; *pallidus*, distinctly jointed, pale (Brues); *nigrescens*, indistinctly jointed, cinereous (Brues). Wing nervures pale, weak; *texensis*, radius ("subcosta" Brues) interrupted at node; *pallidus*, radius not interrupted (Brues); *nigrescens*, radius interrupted at node (Brues).

The following accurate measurements were taken by microscope and may best be considered from the comparative standpoint. A Bausch and Lomb instrument, with two-thirds objective and 2-inch eyepiece, tube length 160, is the standard. The figures given below are in spaces which measure 0.0157 mm. The same scale is used later for other species.

Antennæ: Length = 55; fourth segment = 48; greatest breadth = 6.5.

Head: Distance between outer basal corners of antennæ = 17; between inner front edges of eyes = 27; between inner hind edges of eyes = 42; breadth of head = 54.

Mouth parts: Mandible = 22; maxilla = 10; distance to base of palpus or second joint = 6; palpus = 6.

Prothorax: Length = 10; breadth = 28.

Mesothorax: Length = 10; least breadth = 24; greatest breadth = 39.

Balancer, or elytron: Length = 34.

Metathorax: Length = 110.5; præscutum plus scutellum = 54; postlumbium = 13; postscutellum = 43.5; greatest breadth = 47.

Abdomen: Length tenth segment = 18; length œdeagus = 20.

Anterior leg: Trochanter = 29; femur = 35; tibia = 36; tarsus = 29.

Median leg: Trochanter = 25; femur = 35; tibia = 34; tarsus = 29.

Posterior leg: Trochanter = 14; femur = 38; tibia = 30; tarsus = 29.

In addition to these measurements actual measurements by a cruder method were taken, as follows:

Length of body = 3.3 mm.

Length of head and thorax = 2.1 mm.

Breadth of head = 0.8 mm.

Length of wing on costal margin = 1.9 mm; on anal margin = 2.2 mm.

Type.—Cat. No. 10114, U.S.N.M.

5. ACROSCHISMUS PECOSENSIS, new species.

Xenos nigrescens, determinations in collection of Amer. Ent. Soc. Philadelphia.

Host.—*Polistes texanus* Cresson: Pecos, Texas, February 27, September 30; Austin, Texas; Victoria, Texas. *Polistes rubiginosus* Lepeletier: Waco, Texas, August 29; F. C. Bishopp, collector (pl. 7, figs. 3, 7, 12; pl. 8, figs. 1, 4; pl. 9, fig. 7).

Male.—Length, 3.8 mm. Color, brown; antennæ, light brown; mandibles brown at base, yellow at tip; eyes black; wings with costal margin brown; legs lighter, yellowish; œdeagus clear yellow. Antennæ as long as breadth of head, very sensitive, pubescent, first joint concave for reception of second. Maxillæ yellowish, pubescent, narrowed to one-half original diameter beyond middle, apically rounded; palpus arising at the apical one-third and somewhat surpassing the apical lobe of the maxilla. Mandibles ensiform, over twice the length of the maxillæ. Mesostigmatal lobe present. Œdeagus reflexed, angled at thickest point above, apex turned at an obtuse angle above. It differs from that of *A. pallidus* in that the latter is rounded at the thickest point, and has the apex turned at an acute angle above.

The following accurate measurements were taken on the same scale as in *A. pallidus texensis*, one space = 0.0157 mm.

Antennæ: Length = 67; fourth segment = 60; greatest breadth = 7.

Head: Distance between outer basal corners of antennæ = 25; between inner front edges of eyes = 32; between inner hind edges of eyes = 46; breadth of head = 65.

Mouth parts: Mandibles = 26; maxilla = 12; distance to base of palpus or second joint = 8; palpus = 4.

Prothorax: Length = 12; breadth = 30.

Mesothorax: Length = 10; least breadth = 25; greatest breadth = 38(?).

Balancer, or elytron: Length = 39.

Metathorax: Length = 122; præscutum plus scutellum = 56; postlumbium = 8; postscutellum = 56; greatest breadth = 53.

Abdomen: Length tenth segment = 15; length œdeagus = 18.

Anterior leg: Trochanter = 30; femur = 30 (?); tibia = 45; tarsus = 35.

Median leg: Trochanter = 32; femur = 33; tibia = 36; tarsus = 31.

Posterior leg: Trochanter = 15; femur = 39; tibia = 29; tarsus = 31.

In addition the following measurements were taken by cruder methods:

Length of body = 3.8 mm.

Length of head and thorax = 2.4 mm.

Breadth of head = 1 mm.

Length of wing on costal margin = 2.6 mm; on anal margin = 2.8 mm.

Female.—Length of cephalothorax 1.57–1.77 mm., breadth at spiracles 1.67–1.71 mm., breadth at base of head 1.35–1.36 mm., distance between mandibles at base 0.28–0.35 mm. Cephalothorax light brown with a broad dark-brown band at base; broader than long; margin convex from base to apex, slightly depressed or concave in front of mandibles; spiracles not laterally prominent; mandibles distant from lateral margins of head, deeply bilobed at apex, the inner lobe acute, the outer obtuse.

The larger measurements are from a specimen from *Polistes rubiginosus* taken at Waco, Texas, and which may belong to a distinct species. The species is variable, as shown by specimens in the same lot, and may even include *A. maximus*, since the ratios for this species are included in each case within the range of *A. pecosensis*.

Cotypes.—Cat. No. 10120, U.S.N.M.; and in Academy of Natural Sciences, Philadelphia.

6. ACROSCHISMUS WHEELERI Pierce (1908).

Xenos peckii BRUES, 1903.

Host.—*Polistes metricus* Say, Colebrook, Connecticut, August; Washington, D. C., September 6, 7 (U. S. D. A. 3513°) (pl. 5, figs. 8, 9, 12, 13; pl. 9, fig. 10).

The following description is from Brues:

> *Male.*—Length, 3–4.5 mm. Dark fuscous, abdomen usually lighter and pale at apex. Mandibles black at base, pale at tips, antennæ yellowish gray, the rami of third joint about one and one-third as long as the width of the head. Head fuscous. Palpi indistinctly two-jointed, the second joint only one-half as long as the first and not separated from it ventrally, so that the palpus appears to be obliquely cleft, the first joint being obliquely truncate at apex. Dorsum of thorax varying from fuscous to piceous, darkest medially, elytra gray. Abdomen usually yellowish gray above,

often darker; ventral surface honey yellow; sexual organs pale yellow. Wings stout, subhyaline, the veins very strong and dark, the wing being fuscous along the margins of the veins, so that they appear rather wide capital. Subcostal (radial) nervure interrupted slightly before the middle; costal margin infuscated on basal two-thirds. Legs grayish luteous, darkened on upper side of femora and tibiæ and especially so on the tarsi.

Female.—Length 6.25-9 mm. Head (cephalothorax) above orange, irregularly blackened on posterior half. The black portion emarginate in front at the middle and not extending so far forward on the sides, so that the black extends forward as a projection on each side of the middle. Anterior half of thorax (abdomen) fuscous or piceous, with black wrinkles on the sides. Dorsal abdominal stripe usually quite dark in front and fading out posteriorly, sometimes obsolete. Genital pores distinctly visible externally.

About a dozen males, numerous male pupæ and over 80 females collected by Dr. W. M. Wheeler at Colebrook, Connecticut, during the month of August (Brues, 1903).

7. ACROSCHISMUS BOWDITCHI, new species.

Xenos peckii Bowditch, 1903.
Acroschismus bowditchi Pierce (Dury, 1906).

Host.—*Polistes pallipes* Lepeletier, Marion, Massachusetts, September 2-12, 1902, (Fred C. Bowditch, collector); Cincinnati, Ohio, June 15-September 22, (Charles Dury, Miss Annette F. Braun, collectors) (pl. 7, figs. 2, 6, 11; pl. 9, fig. 1).

Male.—Length 3.25 mm. Antennæ light brown; mandibles brown; eyes black; wings with costal margin brown; legs lighter; œdeagus clear yellowish. Antennæ longer than breadth of head, very sensitive, pubescent. Maxillæ light brown, pubescent. Mandibles ensiform, curved near base, longer than maxillæ. Mesostigmatal lobe present. Œdeagus reflexed, broadly rounded at thickest point above, apex turned almost at a right angle.

Female.—Length of cephalothorax 1.03 mm., breadth at spiracles 1.40 mm., breadth at base of head 1.12 mm., distance between mandibles at base 0.29 mm. Cephalothorax light brown with a dark-brown band at base; slightly broader than long; margin very convex from base to spiracles, almost straight thence to point opposite base of mandibles, apically broadly convex-angulate; spiracles not laterally prominent; mandibles distant from lateral margins of head, oblong-quadrate, with large outward curved tooth on inner angles.

Type.—Cat. No. 10117, U.S.N.M.

Named in honor of Mr. Fred C. Bowditch, who collected the types, in return for his courtesies in assisting the writer with material.

8. ACROSCHISMUS HUNTERI, new species.

Host.—*Polistes*, new species, near *minor* Beauvais; Victoria, Texas, September 25, 1906, J. C. Crawford, collector; June 27, 1906, C. R. Jones, collector (pl. 7, fig. 10; pl. 9, fig. 4).

Male.—Length 4 mm. The color may not be satisfactorily described, as the specimen was extracted from its puparium. Antennæ slightly longer than the breadth of the head, very sensitive, basally arising under a projecting flap, the first, second, and third joints concave for reception of following joint, but first not concealing second, basal joints lighter than rami, and not sensitive. Maxillæ bent at base thence cylindrical, pubescent, obliquely truncate at apex; palpus arising from center of truncation, elliptical, pubescent, almost one-half the length of the maxilla, and about one-half as thick in diameter. Mandibles ensiform, strongly curved throughout, with tip slightly recurved, surpassing the maxillæ and palpus by the lengths of the palpus. Mesostigmatal lobe present. Œdeagus reflexed, broadly rounded at thickest point above, apex turned almost at a right angle.

The following measurements were taken by microscope and may be considered in the same light as those preceding. A Bausch and Lomb instrument, with two-thirds objective, 2-inch eye-piece, tube length 160, is the standard used. The figures given below are in spaces which measure 0.0157 mm.

Antennæ: Length = 60; fourth segment = 53; greatest breadth = 7.

Head: Distance between outer bases of antennæ = 22; between inner front edges of eyes = 33; between inner hind edges of eyes = 45; breadth of head = 57.

Mouth parts: Mandibles = 22.5; maxilla = 11; distance to base of palpus or second joint = 10; palpus = 4.

Prothorax: Length = 9; breadth = 22.

Mesothorax: Length = 10; least breadth = 22; greatest breadth = 30.

Balancer or elytron: Length = 48.5.

Metathorax: Length = 105.5; præscutum plus scutellum = 50; postlumbium = 11.5; postscutellum = 44; greatest breadth = 43.

Abdomen: Length tenth segment = 18; length œdeagus = 20.

Anterior leg: Trochanter = 20; femur = 29; tibia = 33; tarsus = 30.

Median leg: Trochanter = 26; femur = 34; tibia = 30; tarsus = 28.

Posterior leg: Trochanter = 16; femur = 30 (remainder could not be measured).

Female.—Length of cephalothorax 1.29 mm., breadth at spiracles 1.21 mm., breadth at base of head 0.96 mm., distance between mandibles at base 0.22 mm. Cephalothorax light brown with a dark band covering the basal two-thirds; slightly longer than broad; not greatly constricted at base, margin slightly convex to apical truncation, apex slightly sinuate convex; spiracles dorsal, not reaching lateral edges; mandibles large quadrate with a large outward curved tooth near inner angle on apical side.

Type.—Cat. No. 10115, U.S.N.M.

Named in honor of W. D. Hunter, the writer's immediate superior, who has greatly encouraged and aided the present work.

9. ACROSCHISMUS TEXANI, new species.

Host.—*Polistes texanus* Cresson, July 25, 1906, Victoria, Texas (pl. 9, fig. 9).

Female.—Length of cephalothorax 1.59 mm., breadth at spiracles 1.56 mm., breadth at base of head 1.06 mm., distance between mandibles at base 0.27 mm. Cephalothorax brown, lighter toward apex; slightly longer than broad; constricted at base, margin convex to apex with slight sinuations in front of mandibles and at side of head; spiracles dorsal, not reaching lateral edges; mandibles large quadrate with large tooth on inner apical angle.

Type.—Cat. No. 10121, U.S.N.M.

10. ACROSCHISMUS RUBIGINOSI, new species.

Host.—*Polistes rubiginosus* Lepeletier; Logansport, Louisiana, June 6, 1906; W. D. Pierce, collector (pl. 9, fig. 11).

Female.—Length of cephalothorax 1.67 mm., breadth at spiracles 1.59 mm., breadth at base of head 1.17 mm., distance between mandibles 0.30 mm. Cephalothorax dark brown to line between posterior angles of head, thence much lighter; slightly longer than broad; constricted at base, margin oblique with emarginations in front of spiracles, and at base of head, between which it is slightly convex; apically sinuate truncate; spiracles dorsal; mandibles subquadrate, apically strongly emarginate between outward curving tooth on inner angle and rounded lobe of outer angle.

Type.—Cat. No. 10119, U.S.N.M.

11. ACROSCHISMUS MAXIMUS, new species.

Host.—*Polistes rubiginosus* Lepeletier, Texas (pl. 9, fig. 8).

Female.—Length of cephalothorax 1.71 mm., breadth at spiracles 1.10 mm., breadth at base of head 1.48 mm., distance between mandibles 0.32 mm. Cephalothorax dark brown, lighter at apex and in large median emargination of the dark pigment; considerably longer than broad; constricted at base, margin somewhat concave from widest point to base of head, thence very convex to apex, rounding emarginate in front of mandibles, spiracles dorsal; mandibles considerably wider at base than at apex, apically emarginate between large tooth on inner angle and the large blunt outer angle.

Type.—Cat. No. 10118, U.S.N.M.

11. Genus SCHISTOSIPHON Pierce (1908.)

Type of genus.—*Schistosiphon peckii* Kirby (1813).

Name derived from *σχιστός* = cleft + *σιφών* = siphon = cleft siphon, referring to the apical cleavage of the œdeagus. This genus lies between the typical European *Xenos* and the typical American

Acroschismus, differing from the former in wing venation and from the latter in genitalia. The antennæ taper as in *Xenos*. The œdeagus is not bounded at its base by reflexed lobes, is basally bisulcate and apically cleft. The wings have seven primary veins from the base, with one unattached distal vein between the radius and medius and one between the medius and cubitus.

The genus is parasitic upon *Polistes* and is confined to North America.

1. Palpi with first joint longer than second............................*peckii* Kirby.

1. SCHISTOSIPHON PECKII Kirby (1813).

Xenos vespæ Peck in correspondence.
Xenos peckii Kirby, 1813.
Schistosiphon peckii Pierce, 1908.

Host.—*Polistes fuscatus* Fabricius; near Cambridge, Massachusetts (pl. 5, figs. 5, 6).

The original description by Kirby is essentially as follows:

Male.—Dark fuscous, antennæ with rami subterete, dilutely albo-punctate, anus pallid, legs yellowish, tarsi fuscous. Length 1½ line (0.15 inch); breadth of head at eyes, 0.04 inch, length of antennæ 0.045 inch. Body dark fuscous, minutely pubescent, velvety. Head between antennæ longitudinally elevated and almost carinate. Maxillæ longer than their palpi, fuscous, minutely white pubescent, subdiaphanous. Thorax with postscutellum longitudinally and transversely canaliculate; postlumbium pale. Wings whitish cinereous; margin thickened, veins black. Legs cinereous or dusky; tarsi darker. Abdomen more obscure than the rest of the body; anus pale rufescent.[a]

12. VESPÆXENOS, new genus.

Name derived from *Vespa* (the host genus) + *Xenos* (the original genus of wasp parasites), meaning a xenid parasite of *Vespa*.

Type of genus.—*Vespaexenos crabronis*, new species.

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[a] *Male.*—X. nigro-fuscus, antennis; ramis semiteretibus dilutioribus albo punctatis, ano pallido, pedibus luridis; tarsis fuscis. Long. corp. 1½ lin. (Professor Peck's measurements of fresh specimens: Length of body 0.15 inch, breadth of head at eyes 0.04 inch, length of antennæ 0.045 inch.) Corpus nigro-fuscum, ex pube brevissima et nisi sub lente forti omnino inconspicua opacum et quasi velutinum. Caput inter antennas longitudinaliter elevatum et ferè carinatum. Palpi articulo primo secundo longiori. Antennae capite longiores; ramis magis dilutè fuscis, subdiaphanis, punctis minutissimis albis, et, uti suspicor, hexagonis, nisi sub lente forti vix conspicuis irroratis. Truncus. Thorax posticè in medio obtusangulus. Scutellum longitudinaliter et late canaliculatum. Postlumbium pallidum. Alae cinereo-albidae; margine crassiori, nervisque nigris. Pedes cinerei vel potiùs luridi; tarsis nigricantibus. Abdomen reliquo corpore magis obscurum; ano pallide rufescentii (Kirby, 1813).

The genus is restricted to parasites of *Vespa* and is at present confined to Asia.

Male.—At present unsatisfactorily described.

Female.—Typically xenine, but larger than any other known genus. Most nearly approaching the shape of *Acroschismus*.

Triungulinid in general similar to that of *Acroschismus*.

1. VESPÆXENOS CRABRONIS, new species.

Host.—*Vespa crabro* Linnæus; Japan.

Female.—Length of cephalothorax 3.15 mm., greatest breadth 2.95 mm., breadth at spiracles 2.73 mm., breadth at base of head 2.35 mm., distance between mandibles 0.63 mm. Cephalothorax rounded, constricted at base, widest point just behind spiracles, spiracles dorso-lateral, not visible from ventral side, large convex; margin deeply constricted in front of spiracles, then abruptly enlarging, from thence broadly convex to apex; mandibles very large, quadrate, deeply emarginate at apex, apical angles large, obtuse.

Type.—Cat. No. 12667, U.S.N.M.

2. VESPÆXENOS MOUTONI Buysson (1903).

Xenos moutoni Buysson, 1903, 1904.

Host (typical).—*Vespa mandarina* Smith; also recorded on *Vespa magnifica* Smith, *Vespa nigrans* Buysson; China (Yun-nam, Tsé-kou, Ngan-hoei, Yng-chan).

Female.—Length 17 mm.; length of abdomen 6 mm. Cephalothorax yellowish, bordered with brown, extremity with a little subtriangular plaque, emarginate at apex; base of cephalothorax having on each side a little whitish spiracle surrounded with brown; abdomen 9 segmented, the first narrowed into the form of a collar, the last very large; a large yellowish band more chitinous, running the entire length of the dorsum, represents the ventral brood canal.

3. VESPÆXENOS BUYSSONI, new species.

Xenos moutoni R. du Buysson, 1906.

The following description is taken from the account furnished by Buysson in 1906.

Host.—*Vespa ducalis* Smith; Hué, Annam; collected by E. Fleutiaux, 1905, in Museum of Paris.

Male.—Similar to *Xenos vesparum* Rossi, from which it is distinguished by its larger size, its smooth, brilliant body, without velvety pubescence; by the much longer præscutum, which is about twice as long as the width of its base, and finally by the more elongate scutellum, with its less arcuate sides. Length 5 mm. ("Ecusson" has been translated as præscutum, and "segment mediaire" as scutellum, but this may be entirely wrong.)[a]

2. PSEUDOXENINI, new tribe.

Pseudoxenides SAUNDERS, 1872.

Type genus.—*Pseudoxenos* Saunders (1872).

Parasitic on Eumenidæ.

The tribe includes three genera:

13. *Pseudoxenos* Saunders (1872), parasitic on *Odynerus* (sens lat.); Europe.

14. *Leionotoxenos* Pierce, parasitic on *Leionotus;* America.

15. *Monobiaphila* Pierce, parasitic on *Monobia;* America.

The author has used a grouping into tribes of those genera parasitic on hosts of the same family, believing that as soon as sufficient material is at hand this grouping will be justified. For this reason the tribe is limited to the eumenid parasites.

13. Genus PSEUDOXENOS Saunders (1872).

Name derived from ψεῦδος (so called) + *Xenos*, meaning so-called *Xenos.*

Type of genus.—*Pseudoxenos schaumii* Saunders (1872).

The genus is, in the broad sense, parasitic on the old genus *Odynerus*, but in the typical sense on the genus *Ancistrocerus*, formerly a part of *Odynerus*. At present it is known only from Europe.

The genus can only be satisfactorily characterized at present by the presence of eight longitudinal veins in the wings, with two disconnected veins between the radius and medius. The further generic character, the general form of the genital apparatus, is as yet undescribed. Saunders's use of the antennæ is without doubt unavailable, due to alteration of shape on drying.

1. PSEUDOXENOS SCHAUMII Saunders (1872).

Host.—*Ancistrocerus* (*Odynerus*) *parietum* Linnæus; Corcyra, October (pl. 10, fig. 2).

This species was described by Saunders as follows:

Black, with antennæ, maxillæ, elytra, and legs brown; abdomen flavescent, with a transverse brown vitta on each dorsal tergite except the first; anal process piceous; wings hyaline, veins piceous; costal area opaque. Length 1⅗ line.[a]

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[a] Obtenu d'une pupe portée sous le 4e tergite abdominal d'une ouvriere de *Vespa ducalis* Sm., provenant de Hué, dans l'Annam (E. Fleutiaux, 1905, Museum de Paris); le céphalothorax de la pupe faisant légèrement saillie sur le coté droit de la guêpe.

Male.—Semblable au *Xenos vesparum* Rossi mâle, dont il se distingue par sa grande taille, son corps lisse et brilliant, sans tomentum velouté; par l'écusson beaucoup plus long, sa longueur étant égale environ à deux fois la largeur de sa base; enfin par le disque du segment médiaire plus allongé les cotés moins arqués. Long. 5 mil. (Buysson, 1906).

Saunders drew his description of the genus from this species, and as the characters are mainly specific they must be incorporated in the specific description.

Maxillæ with basal joint short, robust; palpi elongate, subcylindrical, pubescent, deflexed. Mandibles elongate, ensiform. Antennæ with basal joint short, apically dilated, with internal angle porrect; second transverse, very small; third produced internally in a compressed, uniform flabellum with apex subobtuse; fourth lamelliform, very similar, almost equal in length, inserted at base of the preceding, and recumbent upon it. Wings with costal margin thickened to middle; radius abbreviated, the area between subcosta and radius clouded; medius strongly sinuate, almost attaining external margin of wing; cubitus fine; the three anal veins simple, thickened at base, beyond middle attenuate. Legs elongate, slender; four anterior trochanters about equaling femora, posterior pair shorter; tibiæ slender, elongate, with apex hardly dilated; tarsi dark, with apical angles of each joint prominent, base slender; joints diminishing in length, apical joint rounded.[b]

2. PSEUDOXENOS KLUGII Saunders (1852).

Xenos klugii SAUNDERS, 1852.
Pseudoxenos klugii SAUNDERS, 1872.

Host.—*Hoplomerus* (*Odynerus*) *lævipes* Shuckard; Epirus, May.

This species was very briefly described as follows:

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[a] Niger; antennis, palpis, elytris, pedibusque brunneis; abdomine flavescente, segmento singulo, basali excluso (septem), disco dorsali ventralique vittâ transversali abbreviatâ brunneâ; processu anali piceo; alis hyalinis, neuris piceis; areâ costali opacâ. Long. corp. 1⅗ lin. (Saunders, 1872, 44).

[b] Palpi articulo basali brevi, robusto, secundo elongato, subcylindrico, hirto, deflexo. Mandibulæ elongatæ, ensiformes. Antennæ 4-articulatæ; articulo basali brevi, apice dilatato, angulo interno porrecto; secundo transversali, minimo; tertio in ramum internum subrectum, compressum, uniformem, apice subobtusum, producto; quarto lamelliformi, simillimo, longitudine fere coæquali, ad basin præcedentis inserto, in illum recumbente, spatio libero vix basi relicto. Alæ costæ dimidio basali inspissato; neura postcostali abreviata, areâ costali latâ nebulosâ, ultra neuras productâ, neurâ externo-mediâ valde sinuatâ, ultra medium alæ tenuissimâ, ad marginem exteriorem vix attingente; area intermedia superior neurâ primâ insulatâ duplicatâ abbreviatâ; secundâ insulatâ elongatâ, valde sinuatâ, simplice, de margine exteriori usque ad neuram externo-mediam basin versus fere attingente; area intermedia inferior neurâ primâ (subexterno-mediâ) gracillimâ, aliisque tribus simplicibus, basi inspissatis, ultra medium tenuissimis; quarum ultima analis. Pedes omnes elongati, graciles; trochanteres anteriores 4 femoribus fere coæquales; postici 2 breviores; tibiæ tenues, elongatæ apice vix dilatatæ; tarsi nitidi, articulis apice angulis prominulis, basi tenuissimis; articulo primo paulo longiore, reliquis longitudine diminuentibus, apicali rotundato integro. Puparium, operculo oculorum situ fenestralis paucis minutissimis instructo. (Saunders, 1872, p. 44.)

Male.—A little larger than *Pseudoxenos heydenii;* antennæ more slender; legs pale.[a]

3. PSEUDOXENOS CORCYRICUS Saunders (1872).

Paraxenos corcyricus SAUNDERS, 1872.

Host.—*Hoplomerus* (*Odynerus*) *spinipes* Linnæus; Corcyra, May.

The description of this species was also brief.

Male.—Differs from *Paraxenos erberi* by its shorter antennæ, broader antennal rami, legs very long, slender, luteous. Length ⅚ line.[b]

4. PSEUDOXENOS HEYDENII Saunders (1852).

Xenos heydenii SAUNDERS, 1852.
Pseudoxenos heydenii SAUNDERS, 1872.

Host.—*Odynerus deflendus* Saunders; Epirus, Corcyra, July-October.

This species may be described as follows:

Male.—Very black; antennal rami densely clothed with minute white tubercles; wings hyaline, with veins piceous; legs luteous. Length 1 line.[c]

14. LEIONOTOXENOS, new genus.

Type of genus.—*Leionotoxenos jonesi* Pierce.

Name derived from *Leionotus* (the host genus) + *Xenos* (the typical parasite genus).

This genus is formed to include those forms which are parasitic upon the genus *Leionotus* and is at present confined to North America. The form of the female shows it to be typically xenid as does also the triungulinid.

The genus is composed of three species:

jonesi Pierce, parasitic on *Leionotus colon* Cresson; Louisiana.
louisianæ Pierce, parasitic on *Leionotus vagans* Saussure; Louisiana.
hookeri Pierce, parasitic on *Leionotus verus* Cresson; Texas.

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[a] Præcedente (*Ps. heydenii*) paulo major; antennis subtilioribus pedibus pallidis. Habitat Epirum, cum *Odynero lævipede,* Shuck. (*O. rubicola* Dufour et Perris), in rubis exsiccatis, cellulas limosas construente, ex quibus imagines, cum alumnorum pupariis expositis, Maio mense exeunte evadunt (Saunders, 1872, 45).

[b] A præcedente (*Paraxenos erberi*) differt antennis brevioribus, ramis latioribus, pedibus cunctis longissimis, tenuibus, luteis. Long. corp. ⅚ lin. Habitat Insulam Corcyram cum *Odynero spinipede* L., cujus exemplar, marium puparia quatuor subabdominis segmentis 2°, 3°, 4°, et 5°, superne alternatim dextra sinistraque exhibens, in sabuletis die Maii lectum; e quibus die 22 ejusdem mensis imagines tres obtinui (Saunders, 1872, 46).

[c] Aterrimus; antennarum rami tuberculis minutis albis dense bullati; alis hyalinis neuris piceis, pedibus luteis. Long. corp. 1 lin. Habitat Epirum et Insulam Corcyram, *Odyneri deflendi* alumnus; a Julio ineunte usque ad Octobris idus, mares in pupariis cum altoribus lecti; fœminæ parturientes quoque diebus Julii decimo tertio, Augusti nono, et Octobris undecimo, cum eâdem Odyneri specie prehensæ (Saunders, 1872, 45).

The generic ratio has been obtained from measurements of the females of the three species, the ratios being between the following dimensions: (2) = distance from line between spiracles to apex, (3) = distance between mandibles, (4) = breadth at base of head, (5) = breadth at spiracles.

Species.	(5):(3)::—:1.	(4):(3)::—:1.	(5):(4)::—:1.	(5):(2)::—:1.
jonesi	5.11	4.44	1.15	1.64
louisianæ	4.66	4.00	1.16	1.61
hookeri	5.09	4.90	1.03	1.33
The generic ratios	4.66–5.11	4.00–4.90	1.03–1.16	1.33–1.64

1. LEIONOTOXENOS JONESI, new species.

Host.—Leionotus colon Cresson (det. W. H. Ashmead); Mound, Louisiana, May 12, 1905, C. R. Jones, collector; Kerrville, Texas, June 2, 1906, F. C. Pratt, collector (pl. 11, fig. 3).

Female.—Length of cephalothorax 1.04 mm., breadth 1.01 mm., breadth of head 0.91 mm., distance between mandibles 0.19 mm. Cephalothorax light brown, with lateral margins narrowly darker, spiracles light on dark background; broadly oval, constricted at base, widest just behind spiracles, obliquely convex to apex; spiracles dorsal; mandibles armed with long tooth at inner apical angle.

Type.—Cat. No. 10123, U.S.N.M.

Named in honor of the writer's former associate, Mr. C. R. Jones. who has materially assisted in this work.

2. LEIONOTOXENOS LOUISIANÆ, new species.

Host.—Leionotus vagans Saussure (det. W. H. Ashmead); Mound, Louisiana, May 12, 1905, C. R. Jones, collector; Lincoln, Nebraska, July (pl. 11, fig. 4).

Female.—Length of cephalothorax 0.87 mm., breadth 0.91 mm., breadth of head 0.76 mm., distance between mandibles 0.19 mm. Cephalothorax brown, lighter on disk basally, and in front of mouth, darker on lateral margin, spiracles light on dark background; very broadly oval, narrowed from spiracles to base, convex from spiracles to apex; spiracles laterally prominent; mandibles very short and broad, armed with short tooth at inner angle.

Triungulinid: Length 0.16 mm., length including stylets 0.22 mm., breadth of head 0.04 mm., greatest breadth 0.08 mm., breadth ninth abdominal segment 0.04 mm. Head elongate, abdominal segments 1–8 short, but normal; ninth segment elongate, as long as three preceding, deeply emarginate for tenth; tenth segment hardly surpassing the lateral prolongations of the ninth, apically provided with two contiguous stylet bearing lobes.

Type.—Cat. No. 10124, U.S.N.M.

3. LEIONOTOXENOS HOOKERI, new species.

Host.—*Leionotus verus* Cresson (det. W. H. Ashmead); Dallas, Texas, July 21, 1906, on *Helenium tenuifolium;* W. A. Hooker, collector (pl. 11, fig. 2; fig. 1, p. 31).

Female.—Length of cephalothorax 1.21 mm., breadth 1.37 mm., breadth of head 1.17 mm., distance between mandibles 0.19 mm. Cephalothorax brown, lighter basally on disk, much darker on lateral margins; broader than long, constricted at base, angularly convex from spiracles to apex, the angles being at base of head, at sides of mandibles, and in front of mandibles; spiracles dorsal; mandibles broad, apically emarginate with tooth on inner angle.

Triungulinid: Length 0.21 mm., length including stylets 0.28 mm., breadth of head 0.07 mm., greatest breadth 0.09 mm., breadth with abdominal segment 0.05 mm.

Type.—Cat. No. 10125, U.S.N.M.

Named in honor of the writer's associate, W. A. Hooker, who collected the types.

15. MONOBIAPHILA, new genus.

Name derived from *Monobia*+*φίλα* (loving), meaning fond of *Monobia.*

Type of genus.—*Monobiaphila bishoppi,* new species.

The genus is parasitic on the odynerid genus *Monobia,* which is broadly scattered over the United States. The form of the female shows it to be xenid and closely related to *Leionotoxenos.*

Only one species is known, *bishoppi* Pierce, parasitic on *Monobia quadridens* Linnæus; Texas.

The generic ratio is obtained, therefore, from this one species: (2) = distance from line between spiracles to apex, (3) = distance between mandibles, (4) = breadth at base of head, (5) = breadth at spiracles.

Species.	(5):(3)::—:1.	(4):(3)::—:1.	(5):(4)::—:1.	(5):(2)::—:1.
bishoppi	6.93	4.40	1.60	1.76

1. MONOBIAPHILA BISHOPPI, new species.

Host.—*Monobia quadridens* Linnæus; collected at Wolfe City, Texas, May 31, 1906, and at Orange, Texas, August 23, 1906, by F. C. Bishopp (pl. 11, fig. 1).

Female.—Length of cephalothorax 1.78 mm., breadth at spiracles 1.86 mm., breadth of head 1.48 mm., distance between mandibles 0.34 mm. Cephalothorax brownish, light on disk to line between posterior angles of head, dark on margins and front of prothorax, light in front of mouth and mandibles; broader than long, constricted at base, broadest at spiracles, convex from base to spiracles, slightly oblique but very nearly straight from spiracles to base of head, a small abrupt emargination at base of head, thence very oblique, straight to mandibles, apex convex; spiracles dorsal, showing light on dark background; mandibles broad, apically emarginate between the long curved tooth on the inner angle and the obtuse outer angle.

Triungulinid: Length 0.25 mm., length including stylets 0.34 mm., breadth of head 0.07 mm., greatest breadth 0.10 mm., breadth ninth segment 0.06 mm. Similar to that of *Leionotoxenos.*

Type.—Cat. No. 10122, U.S.N.M.

Named in honor of Mr. Fred C. Bishopp, one of the writer's associates, who has been of great assistance in obtaining material for study.

3. PARAXENINI, new tribe.

Pseudoxenides (part) SAUNDERS, 1872.

Parasitic on Bembecidæ.

The tribe includes one genus: *Paraxenos* Saunders (1872), parasitic on *Bembecinus;* Europe.

16. Genus PARAXENOS Saunders (1872).

Name derived from παρά (near) + *Xenos,* meaning related to *Xenos.*

Type of genus.—*Paraxenos erberi* Saunders (1872).

This genus is typically parasitic on the genus *Bembecinus,* and at present is known only from Europe.

The following description is taken from Saunders:

Maxillæ with basal joint stout, arcuate; palpus cylindrical, pubescent, deflexed. Mandibles broader at base, internally strongly emarginate. Antennæ with first joint short apically dilated, with internal angle prominent; second small, subcuneiform; third internally produced into a flabellum, dilated to basal quarter, thence compressed, apically more slender, obtuse; fourth elongate, basally dilated, apically subobtuse, more or less exceeding the branch of the preceding in length. Wings with radius remote from subcosta, subabbreviated; costal area clouded; medius sinuate; a detached branch of radius and one of medius between these veins; cubitus delicate; the three anal veins subapproximate, thickened slightly at base. Legs with anterior trochanters, femora, and tibiæ subequal; tarsal joints almost alike, the basal more robust, the apical more slender; middle pair almost the same; posterior coxæ reniform, with trochanters subovate, robust; tibiæ more slender.[a]

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[a] Palpi articulo basali crasso, arcuato; secundo cylindrico, hirto, deflexo. Mandibulæ basi latiores, interne fortiter emarginatæ. Antennæ 4-articulatæ: articulo primo brevi, apice dilatato, angulo interno prominulo, tertii cubitum versus porrecto: secundo minimo, subcuneiformi, lateribus angulatis: tertis in ramum internum producto, basi externè dilatatum ad quartum recipiendum, deinde subito rectangu-

1. PARAXENOS ERBERI Saunders (1872).

Host.—*Bembecinus peregrinus* Smith; Corcyra, May (pl. 10, fig. 1).

According to Saunders this species may be described as follows:

Male.—Elongate, black, legs fuscous, antennal rami subequal in length. Length $\frac{5}{8}$ line.[a]

4. OPHTHALMOCHLINI, new tribe.

Type genus.—*Ophthalmochlus* Pierce (1908).

Parasitic on Sphecidæ.

The tribe includes three genera:

17. *Sceliphronechthrus* Pierce, parasitic on *Sceliphron;* America.
18. *Ophthalmochlus* Pierce (1908), parasitic on *Priononyx;* America.
19. *Eupathocera* Pierce (1908), parasitic on *Sphex;* America, Europe.

When better studied this tribe may be found to belong to the Homilopinæ, it being only for that reason that it is separated at all.

17. SCELIPHRONECHTHRUS, new genus.

Name derived from *Sceliphron* (the host genus) + ἐχθρός (enemy) = parasite of *Sceliphron.*

Type of genus.—*Sceliphronechthrus fasciati* Pierce.

The genus is parasitic on the genus *Sceliphron* (*Pelopæus*) and at present is only from the West Indies.

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lariter reflexo, reliquo compresso, distorto, basi tumido, apice subtiliore, obtuso: quarto e basi præcedentis retrorsum emergente, in illum inflexo spatio libero intermedio basi relicto, similiter compresso, basi dilatato, apice subobtuso, longitudine præcedentem plus minusve excedente. Alæ costæ dimidio basali cum neurâ mediastinâ (=subcosta) proximo sed distincto; postcostali (=radius) remotâ subabbreviatâ; areâ costali latâ nebulosâ, ultra neuras productâ; neurâ externo-mediâ (=medius 2) sinuatâ, dimidio apicali duplicatâ, tenuissimâ: area intermedia superior (above medius 2) neuris insulatis binis duplicatis (=radius 2 and medius 1), de margine externo retro productis; quarum discoidales paulum longiores, a neurâ externo-mediâ (=medius 2) longe abstantes: area intermedia inferior neuris rectis tenuibus; primâ (subexterno-mediâ) (=cubitus) gracili; aliis e basi radiantibus, subapproximatis, tribus (=anal veins), basi paulum inspissatis, deinde quasi duplicatis, quarum ultima analis. Pedes antice trochanteribus femoris tibiisque longitudine fere æqualibus; tarsorum articulis 4, fere similibus, basali robustiore, apicali tenuiore; intermedii fere consimiles; postici coxis reniformibus, trochanteribus subovatis, robustis; tibiis tenuioribus.

Puparium, operculo oculorum situ fenestrulis paucis minutissimis instructo (Saunders, 1872, pp. 45, 46).

[a] Elongatus, ater, pedibus fuscis, antennarum ramis longitudine fere coæqualibus. Long. corp. $\frac{5}{8}$ lin. In Mus. nostro (British Museum). (Saunders, 1872.)

1. SCELIPHRONECHTHRUS FASCIATI, new species.

Host.—*Sceliphron* (*Pelopæus*) *fasciatus* Lepeletier (det. W. H. Ashmead); Santo Domingo; from collection of the U. S. National Museum (pl. 11, fig. 5).

Female.—Length of cephalothorax 1.38 mm., breadth at widest point 1.36 mm., breadth of head 1.02 mm., distance between mandibles 0.25 mm. Cephalothorax brownish, lighter on disk except in front of spiracles, also lighter in front of mouth and mandibles, margins dark; enlarging obliquely from base to spiracles, widest just behind spiracles, thence narrowing obliquely in wavy lines to mandibles, apically rounded; spiracles laterally prominent; mandibles broad, armed with outward curving tooth on inner apical angle.

Type.—Cat. No. 10128, U.S.N.M.

18. Genus OPHTHALMOCHLUS Pierce (1908).

Name derived from ὀφθαλμός (eye) + ὄχλος (group), signifying the typical strepsipteran cluster eye.

Wings having seven primary veins, the third anal missing, with two distal detached veins between the radius and medius, and one between the medius and cubitus; maxillæ two-jointed; palpi four-jointed; antennæ four-jointed.

Type of genus.—*Ophthalmochlus duryi* Pierce. The genus is parasitic on the genus *Priononyx* and at present is confined to North America.

1. OPHTHALMOCHLUS DURYI Pierce (1908).

Acroschismus duryi PIERCE, MS. (DURY, 1906.)

Host.—*Priononyx atrata* Lepeletier; Cincinnati, Ohio, June 17 (female), August 16–September 21 (males, female). (Pl. 10, figs. 7, 8, 13).

Male.—Length 2.5 mm.; head, prothorax, and mesothorax black; antennæ, legs, and metathorax velvety reddish brown; postlumbium lighter, membranous; wings snowy white, venation very light. Head transverse; vertex medianly produced in a high ridge, on each side of which arise the antennæ; mandibles chitinous, dark in basal half, yellowish in apical half, very acute and curved near tip; palpi two-jointed, black. Scutellum just reaching præscutum in a narrow angle, which separates the scuti; postlumbium as in *Acroschismus*. Œdeagus inflated at base of the general profile found in *Acroschismus*, but very much narrowed at first angle, thence very straight, and near apex abruptly and acutely bent upward, apex very acute.

Triungulinid: Length 0.19 mm., length, including stylets, 0.27 mm., breadth of head 0.06 mm., greatest breadth 0.09 mm., breadth of ninth abdominal segment 0.05 mm. Characters very similar to those of *Leionotoxenos*.

Type.—In Mr. Dury's collection.

Dedicated to Charles Dury, of Cincinnati, Ohio, in return for the many favors he has rendered the writer and in acknowledgment of the new species in the group which he has discovered.

19. Genus EUPATHOCERA Pierce (1908).

Name derived from *εὐπαθὴς* (sensitive) + *κέρας* (horn), meaning sensitive antenna, referring to the characteristic sensitive surface of the strepsipteran antennæ.

Wings with eight primary veins; with two distal detached veins between the radius and medius, and one detached vein between the medius and cubitus; postlumbium very short, transverse, and not differing in consistency from the scutellum or post-scutellum.

Type of genus.—*Eupathocera lugubris* Pierce. The genus is typically parasitic on *Sphex* (the old genus *Ammophila*), and is typically North American, although European species have been added because of congeneric hosts.

1. EUPATHOCERA LUGUBRIS Pierce (1908).

Acroschismus lugubris Pierce, MS. (Dury, 1906.)

Host.—*Sphex* (*Ammophila*) *fragilis* Smith; Cincinnati, Ohio, September 3, October 2; Charles Dury, collector (pl. 10, figs. 11, 12, 14).

Male.—Length 2.25 mm. Head and thorax jet black; antennæ, legs, and abdomen brown; wings snowy white, venation almost invisible. Head transverse, vertex medianly produced in a high ridge, on each side of which arise the antennæ; antennæ typically xenid; mandibles chitinous, flattened, scimitar-like; palpi two-jointed, black. Scutellum anteriorly acute angled, reaching præscutum; postlumbium very short, transverse, and not differently colored or of different consistency from the surrounding parts. Œdeagus almost as in *Ophthalmochlus.*

In *Acroschismus* the scutellum sends forward a narrow stem to meet the præscutum and has the postlumbium more than one-fourth as long as wide and of a different color and consistency from the surrounding parts.

Type.—In Mr. Dury's collection.

2. EUPATHOCERA PRUINOSÆ, new species.

Host.—*Sphex* (*Ammophila*) *pruinosa* Cresson; Canyon City, Colorado, August; Denver, Colorado; J. S. Hunter, collector; from collection of the University of Nebraska (pl. 11, fig. 7).

Female.—Length of cephalothorax over 1.05 mm., breadth at spiracles 1.17 mm., breadth of head 0.95 mm., distance between mandibles 0.16 mm. Cephalothorax dark brown except toward base on disk;

widest behind spiracles, more or less evenly convex throughout; spiracles dorsal; mandibles subquadrate, with a large tooth on inner apical angle.

Triungulinid: Length 0.16 mm., length, including stylets, 0.24 mm., breadth of head 0.05 mm., greatest breadth 0.09 mm., breadth of ninth abdominal segment 0.05 mm. This triungulinid belongs to the same type as that of *Leionotoxenos*.

Type.—Cat. No. 10129, U.S.N.M.

3. EUPATHOCERA SPHECIDARUM Dufour (1837).

Xenos sphecidarum DUFOUR, 1837.—SIEBOLD, 1839.
Paraxenos sieboldii SAUNDERS, 1872 (part).
Eupathocera sphecidarum PIERCE, 1908.

Host.—*Sphex* (*Ammophila*) *sabulosa* Linnæus; Southern France, August; Germany, June.

4. EUPATHOCERA (?) SIEBOLDII Saunders (1872).

Xenos sphecidarum SIEBOLD, 1839 (part).
Paraxenos sieboldii SAUNDERS, 1872.
Eupathocera (?) *sieboldii* PIERCE, 1908.

Host.—*Miscus campestris* Latreille, Germany, June.

Male.—Fuliginous; legs piceous; wings milky, with the anterior margin brown; antennal rami laterally compressed, the inner branch always a little longer. Length 1½ lines; wing expanse 2 lines.

Siebold's original description, given here as a footnote, does not make it clear whether he described the species from the parasites of *Miscus campestris* or *Sphex* (*Ammophila*) *sabulosa*.[a]

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[a] Fuliginosus; pedibus piceis; alis lacteis, margine antico brunneo; antennarum ramis lateraliter compressis, interno semper paulo longiore. Long. corp. 1½ lin. Expans, alar. 2 lin. (Saunders 1872. p. 47).

[The original description by Siebold follows.]

Die Farbe des 1¼ Lin. langen Körpers von *Xenos sphecidarum* ist sammet-schwarz, die Beine schimmern etwas ins Pechbraune, die beiden Flügel sind milch-weiss, der Vorderrand derselben ist braunlich angelaufen; es scheint als wenn auf jedem Flügel drei zarte Nerven von der Wurzel bis zu dem Aussenrande desselben hinlaufen, doch sind es vielleicht nur drei Falten. Bei ausgebreiteten Flügeln hat das Insekt, quergemessen, eine Breite von ohngefähr zwei Linien. Die ganze Gestalt desselben stimmt im allgemeinen mit der des *Xenos rossii* überein.

Der Kopf des Thierchens ist um vieles breiter als lang, sein Vorderrand ist zweimal sanft ausgeschnitten, wodurch in der Mitte eine kleine Spitze hervorragt. Auf dem Rücken des Kopfes zeigen sich eine vordere und hintere Querfurche. Die beiden kugelförmigen Augen ragen zu beiden Seiten des Kopfes auffallend hervor, sie besitzen sehr grosse Facetten, welche in der Mitte weiss gefärbt sind. An der Stirn stehen, etwas entfernt von einander, die eigenthümlichen schwarzen Fühlhörner, deren Basis aus drei kleinen Gliedern besteht, von denen das dritte das kürzeste ist. Von diesem entspringt ein sehr langes und seitlich zusammengedrücktes Glied, aus dessen etwas verdickter Wurzel nach aussen ein zweites langes und ebenfalls seitlich zusammen-

2. Subfamily HOMILOPINÆ Pierce, 1908.

Type genus.—*Homilops* Pierce, 1906.

Parasitic on Sphecidæ. Maxillæ three-jointed.

The subfamily includes—

20. *Homilops* Pierce, parasitic on *Proterosphex;* America, Asia.

The tribe Ophthalmochlini may probably belong with this genus.

20. Genus HOMILOPS Pierce (1908).

Type of genus.—*Homilops westwoodii* Templeton (1838).

Name derived from δμιλος (group) + ὤψ (eye); meaning cluster eye, referring to the grouping of the separated ommatidia into a compound eye.

The genus is parasitic on the sphecid genus *Proterosphex,* formerly known as *Sphex,* and at present contains species from America and Asia. It contains—

1. *westwoodii* Templeton, parasitic on *Proterosphex ichneumoneus;* South America.
2. *bishoppi* Pierce, parasitic on *Proterosphex ichneumoneus;* North America.
3. *ashmeadi* Pierce, parasitic on *Proterosphex pernanus;* Insular America.
4. *abbotti* Pierce, parasitic on *Proterosphex,* species; Siam.

This genus is characterized by the possession of one pair of palpi, which are three-jointed. The genitalia consist merely of a two-jointed plate-like exserted appendage, with the œdeagus not exserted, according to Templeton. The first joint of each tarsus is the longest, while the joints themselves are described by Templeton as appendic-

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gedrückte Glied hervorgeht. Jenes innere Glied ist immer etwas länger als dieses äussere; im Ruhezustande hängen diese beiden langen Glieder nebeneinander auf jeder Seite über das Gesicht des Insektes fast senkrecht gerad, stehen aber an ihrem freien Ende etwas voneinander ab. In der gegend des Mauls stehen ein Paar zweiggliedrige Palpen in ziemlich weiter Entfernung voneinander, sie sind nach unten und innen gebogen, und haben eine schwarze Farbe; das zweite Glied ist kürzer als das erste und länglich oval. Dicht neben diessen Fühlern erkennt man mit Mühe nach innen zwei in die Höhe gebogene und einander zugekehrte braunfarbige Kiefern, sie sind schmal und platt, werden vor ihrem freien Ende etwas breiter und laufen dann in eine kurze Spitze aus (Siebold, 1839).

[The following is a portion of the description of the triungulinid:]

Triungulinid: Die acht folgenden (1st 8 abdominal) Körpersegmente sind sehr kurz und sowohl an den Seiten als auch an dem Hinterrande (jedoch nur auf der Bauchfläche) mit kurzen Borsten eingefasst. Das vorletzte Körpersegment hat eine oblonge Gestalt und sein Hinterrand ist auf der Bauchfläche tief ausgeschnitten; zu beiden Seiten des Ausschnitts steht eine längere Borste und in dem Ausschnitte selbst steckt das letzte sehr dunkel gefärbte Körpersegment fast verborgen. Aus dem hinteren Rande dieses kleinen Segmentes entspringen zwei längere Borsten, zwischen welchen noch zwei sehr lange (Siebold, 1839).

ulate and arising before the apex of the preceding. Antennæ with last two joints dilated in the middle and tapering somewhat to the tip.

1. HOMILOPS WESTWOODII Templeton (1838).

Xenos westwoodii TEMPLETON, 1838.
Paraxenos westwoodii SAUNDERS, 1872.
Homilops westwoodi PIERCE, 1908.

Host.—Proterosphex (*Sphex*) *ichneumoneus auriflus* Perty, Rio Janeiro, Brazil (pl. 10, figs. 9, 10).

Male.—Head small, carrying anteriorly two cupped tubercles, which bear the stout antennæ. The first antennal joint is short, subcylindric, slightly contracted near the base, dilating toward the apex, and internally extended; second joint minute, a little longer than broad, constricted in middle, cupped beneath for third joint; first two joints covered with short rigid hairs and not sensitive; third joint short, cupped for fourth, internally produced, in an elongate, flat process, rounded at tip, and dilated at the middle; fourth joint also produced, exceeding production of third by one-fourth, and dilated at the middle. Margin of pharyngeal opening slightly corrugated; mandibles elongate, narrow, slightly arched; palpi triarticulate; first joint minute; second large, tumid, and a little curved backwards; apical small, cylindric, and densely covered with minute hairs.

2. HOMILOPS BISHOPPI, new species.

Host.—Proterosphex (*Sphex*) *ichneumoneus* Linnæus; Waco, Texas, August 29, 1906; F. C. Bishopp, collector (pl. 11, fig. 6).

Female.—Length of cephalothorax 1.71–2.09 mm., breadth at spiracles 1.86–2.39 mm., breadth of head 1.52–1.82 mm., distance between mandibles 0.27 mm. Cephalothorax brown, lighter on posterior half of disk; broader than long, margins convex oblique, wavy at sides of head; spiracles dorsal; mandibles broad subquadrate with large tooth on inner apical angle.

Type.—Cat. No. 10127, U.S.N.M.

Named in honor of F. C. Bishopp, its collector.

3. HOMILOPS ASHMEADI, new species.

Host.—Proterosphex (*Sphex*) *pernanus* (?) Kohl; Santo Domingo; from the collection of the U. S. National Museum (pl. 11, fig. 8).

Female.—Length of cephalothorax 1.85 mm., breadth at spiracles 2.01 mm., breadth of head 1.63 mm., distance between mandibles 0.32 mm. Cephalothorax brown, lighter on posterior half; regularly convex from base to apex, apex squarely but narrowly truncate; spiracles dorsal; mandibles oblique, apically emarginate, angles acute.

Triungulinid: Length 0.19 mm., length, including stylets, 0.30 mm., breadth of head 0.07 mm., greatest breadth 0.08 mm., breadth of ninth segment 0.05 mm. This triungulinid also belongs to the type represented by *Leionotoxenos*.

Type.—Cat. No. 10126, U.S.N.M.

Named in honor of the late Dr. William H. Ashmead.

4. HOMILOPS ABBOTTI, new species.

Host.—Proterosphex, species, Trong, Lower Siam; from collection of U. S. National Museum.

Female.—Length cephalothorax 2.46 mm., breadth at spiracles 2.62 mm., breadth of head 1.78 mm., distance between mandibles 0.38 mm. Cephalothorax brownish, head lighter; broader than long, constricted at base, broadest just behind spiracles, convex oblique from spiracles to apex, broadly rounding emarginate in front of mandibles; spiracles laterally prominent or at least reaching lateral margin; mandibles oblique, apically emarginate with rounded outer angle surpassing the acute curved tooth of the inner angle.

Named in honor of Dr. W. L. Abbott, its collector.

Type.—Cat. No. 12668, U.S.N.M.

3. Subfamily HALICTOXENINÆ Pierce, 1908.

Type genus.—Halictoxenos Pierce.

Parasitic on Halictinæ.

The subfamily includes two genera, as follows:

21. *Halictoxenos* Pierce, 1908, parasitic on *Halictus*; America, Asia.
22. *Apractelytra* Pierce, 1908, host unknown; America.

21. Genus HALICTOXENOS, Pierce (1908).

Name based on *Halictus* + *Xenos*, meaning a xenid parasitic on *Halictus*.

Type of genus.—Halictoxenos jonesi, new species.

The genus is parasitic on *Halictus* and contains the following species:

1. *jonesi* Pierce, parasitic on *Halictus*, species; Louisiana.
2. *crawfordi* Pierce, parasitic on *H. bruneri* Crawford; Nebraska.
3. *grænicheri* Pierce, parasitic on *H. albipennis* Robertson; Wisconsin.
4. *versati* Pierce, parasitic on *H. versatus* Robertson; Wisconsin.
5. *zephyri* Pierce, parasitic on *H. zephyrus* Smith; Wisconsin.
6. *sparsi* Pierce, parasitic on *H. sparsus* Robertson; Oklahoma.
7. *manilæ* Pierce, parasitic on *H. manilæ* Ashmead; Philippines.
8. *robbii* Pierce, parasitic on *H. robbii* Ashmead; Philippines.

Numerical key to the females.

In the genus *Halictoxenos* the female cephalothorax is very greatly narrowed in front, so that a new series of comparative ratios is obtained which is very different from that of any other genus. The measurements are with a Zeiss stand, 160 tube, 2 eyepiece, and A objective; 1 space = 0.0076 mm.

Species.	1.	2.	3.	4.	5.	6.
	Length.	Spiracles to apex.	Breadth between mandibles.	Breadth of head.	Breadth at spiracles.	Greatest breadth.
manilæ	80	65	11	60	86	86
robbii	80	60	10	57	80	80
crawfordi	76	62	12	38	80	80
grænicheri	76	57	10	40	76	76
zephyri	72	55	9	32	74	74
versati	70	50	7	35	68	68
sparsi	60	40	7	30	62	62

From these figures the following ratios, which are derived as in the discussion of *Stylops*, are obtained:

Species.	Cephalothorax to mandibles. (5):(3)::—:1.	Head to mandibles. (4):(3)::—:1.	Cephalothorax to head. (5):(4)::—:1.	Breadth to length. (5):(2)::—:1.
manilæ	7.81	5.45	1.43	1.32
robbii	8.00	5.70	1.40	1.33
crawfordi	6.66	3.16	2.10	1.29
grænicheri	7.60	4.00	1.90	1.33
zephyri	8.22	3.55	2.31	1.34
versati	9.71	5.00	1.94	1.36
sparsi	8.75	4.28	2.06	1.55

The great difference in shape between the two Philippine species and the American specimens led to the division of this genus into two subgenera.

Subgenus *Halictoxenos* is parasitic on *Chloralictus*, a subgenus of green *Halictus*, and is typically American. The breadth of the cephalothorax is 1.9 to 2.3 times the breadth of the base of the head, and the breadth of the head is 3.1 to 5 times the distance between the mandibles.

Subgenus *Halictophilus* is parasitic on *Evylæus*, a subgenus of black *Halictus*, and is typically Philippine. The breadth of the cephalothorax is 1.4 times the breadth of the base of the head, and the breadth of the head is 5.4 to 5.7 times the distance between the mandibles.

There is very little doubt that when males are found these subgenera will become genera, and that *Halictostylops* of Europe, which is founded on a parasite of a black *Halictus*, will fall near *Halictophilus* of the Philippines and out of the Stylopidæ, where it is now provisionally placed.

HALICTOXENOS, new subgenus.

1. HALICTOXENOS JONESI Pierce (1908).

Host.—*Halictus* (*Chloralictus*), species; Texas; near Logansport, Louisiana, June 7, 1905, W. D. Pierce, collector; Mound, Louisiana, May 12, 1905, C. R. Jones, collector (pl. 13, figs. 1, 2, 3).

Male.—These specimens were given a name, although in both cases they were males extracted from the puparium. The xenid antennæ were sufficient to place the genus properly. The maxillary palpus is large and flattened and at least as long as the maxilla. The balancers are as long or longer than the rami of the antennæ. The œdeagus is evenly curved near base but not enlarged, resembling that of *Apractelytra;* the tip could not be made out. The wings are dark and the venation is strong.

Cephalotheca: The antennal analogues are nearly circular and lie next to the eye and less than one-half their breadth from the arched vertex which lies between them. The mandibular analogues are prominent, acute and considerably nearer the pharynx than the eyes. The maxillary analogues are represented by an ovate ring with a very slight median lobe. They are very near the eyes, nearer by their width than the mandibles.

Named in honor of C. R. Jones, the writer's former associate.

Type.—Cat. No. 12669, U.S.N.M.

2. HALICTOXENOS CRAWFORDI, new species.

Host—*Halictus bruneri* Crawford, cotype, June 10, 1901, West Point, Nebraska, on honeysuckle; J. C. Crawford, collector (No. 202) (pl. 12, fig. 1).

Female.—Length of cephalothorax 0.57 mm., breadth at spiracles 0.61 mm., breadth at base of head 0.28 mm., distance between mandibles 0.09 mm. Cephalothorax very light yellowish brown, darker on basal margin, the dark band extending back over the brood canal; pyriform about as long as broad, suddenly constricted at base, widest behind spiracles, thence rapidly convexly narrowing to base of head, thence oblique, almost straight to mandibles, apically convex truncate; spiracles not laterally prominent; mandibles reaching lateral margin, broader at base than apex, emarginate truncate at apex, outwardly widening toward base.

Triungulinid: Length 0.12 mm. Resembles in general the triungulinid of *Stylops.*

Type.—Cat. No. 10106, U.S.N.M.

This species is named in honor of J. C. Crawford, of the U. S. National Museum, who is an authority on the genus *Halictus* in America, and who collected the type of the species.

3. HALICTOXENOS GRÆNICHERI, new species.

This species is named in honor of Dr. Sigmund Grænicher, of Milwaukee, Wisconsin, who collected two male *Halictus* (*Chloralictus*) *albipennis* Robertson on August 4, 1906, each bearing a female of this species (pl. 12, fig. 2).

Female.—Length of cephalothorax 0.57 mm., breadth at spiracles 0.57 mm., breadth of head 0.30 mm., distance between mandibles 0.07 mm. Cephalothorax light yellowish brown, the dark-brown area of the brood canal extending over the base of the thorax; truncate pyramidal, constricted at base, widest behind spiracles, thence narrowing obliquely to mandibles with a slight emargination at the base of the head; spiracles lateral but not prominent; mandibles near lateral margin, transverse, emarginate at apex.

Type.—Cat. No. 10107, U.S.N.M.

4. HALICTOXENOS VERSATI, new species.

Host.—*Halictus* (*Chloralictus*) *versatus* Robertson; one female bee, Milwaukee, Wisconsin, September 1, 1906 (containing one female); one female, September 10, 1906 (containing one female); and one female, September 22, 1906 (containing three females); S. Grænicher, collector (pl. 12, fig. 4).

Female.—Length of cephalothorax 0.53 mm., breadth at spiracles 0.51 mm., breadth of head 0.26 mm., distance between mandibles 0.05 mm. Cephalothorax yellowish brown, with brown band at base; triangular with rounded truncate apex, strongly constricted at base, widest behind spiracles, thence oblique, slightly convex to mandibles with shallow concave emargination at base of head, apex convex; spiracles lateral, but not prominent; mandibles bluntly triangular, with broad base.

Type.—Temporarily in possession of author.

5. HALICTOXENOS ZEPHYRI, new species.

Host.—*Halictus* (*Chloralictus*) *zephyrus* Smith; Milwaukee, Wisconsin, September 12, 1903; S. Graenicher, collector.

Female.—Length of cephalothorax 0.54 mm., breadth at spiracles 0.56 mm., breadth of head 0.24 mm., distance between mandibles 0.068 mm. Cephalothorax yellowish brown, with a dark band at base; truncate pyramidal, constricted at base, widest at spiracles, thence oblique and almost straight to mandibles, apex rounded at sides, squarely truncate in front; spiracles not laterally prominent; mandibles broad at base, armed with blunt tooth at inner angle.

Type.—Cat. No. 10110, U.S.N.M.

6. HALICTOXENOS SPARSI, new species.

Host.—*Halictus* (*Chloralictus*) *sparsus* Robertson; Ardmore, Oklahoma, April 12, 1907; F. C. Bishopp, collector (pl. 12, fig. 3).

Female.—Length of cephalothorax 0.45 mm., breadth at spiracles 0.47 mm., breadth of head 0.228 mm., distance between mandibles 0.05 mm. Cephalothorax light yellowish brown, with longitudinal dark-brown band as wide as brood canal and extending from spiracles posteriad, being equally on thorax and abdomen; truncate pyramidal, constricted at base, widest behind spiracles, rapidly narrowing to mandibles, shallowly concave at base of head, squarely truncate at apex; spiracles lateral but not prominent; mandibles small with apical tooth.

Type.—Cat. No. 10108, U.S.N.M.

HALICTOPHILUS, new subgenus.

7. HALICTOXENOS MANILÆ, new species.

Host.—*Halictus* (*Evylæus*) *manilæ* Ashmead; Manila, Philippine Islands; Robert Brown, collector; from U. S. National Museum collection (pl. 12, fig. 5).

Female.—Length of cephalothorax 0.608 mm., breadth at spiracles 0.65 mm., breadth of head 0.45 mm., distance between mandibles 0.08 mm. Cephalothorax yellowish brown, with narrow dark-brown strip at base which extends back over abdomen to form a semicircle; stylopiform, abruptly constricted behind spiracles, convex throughout, very shallowly emarginate at base of head; head rounded evenly throughout from base to base, not narrowed and truncate as in the preceding species; spiracles not laterally prominent; mandibles broad, apically armed with two blunt teeth.

Type.—Cat. No. 10112, U.S.N.M.

8. HALICTOXENOS ROBBII, new species.

Host.—*Halictus* (*Evylæus*) *robbii* Ashmead; Manila, Philippine Islands; Robb, collector; from U. S. National Museum (pl. 12, fig. 6).

Female.—Length of cephalothorax 0.608 mm., breadth at spiracles 0.608 mm., breadth of head 0.43 mm., distance between mandibles 0.07 mm. Cephalothorax yellowish brown, darker on middle of disk; stylopiform, abruptly constricted behind spiracles, widest at spiracles, convex throughout, shallowly emarginate at base of head, evenly rounded in front; spiracles not laterally prominent; mandibles subquadrate, with small tooth on inner apical angle.

Type.—Cat. No. 10111, U.S.N.M.

22. Genus APRACTELYTRA Pierce (1908).

Type of genus.—*Apractelytra schwarzi* Pierce.

Name derived from *ἄπρακτος* (abortive) + *ἔλυτρον* (elytron) = aborted elytra.

This genus is characterized by the absence of the cleavage at each side of the base of the œdeagus. The subequal length of the palpal joints is also characteristic. It belongs to the typical Xenidæ, in that it has four-jointed antennæ, four-jointed tarsi, and two-jointed palpi.

1. APRACTELYTRA SCHWARZI Pierce (1908).

Xenos schwarzi Pierce in determinations.

Host.—Unknown.

Locality.—Washington, D. C. (pl. 10, figs. 3, 4, 5, 6).

Male.—Length 1.66 mm. Wing expanse 4 mm. Black, with whitish pubescence. Wings milky, very pubescent. Last ventral segment brownish; œdeagus yellow. Under parts lighter. Head transverse, eyes stalked, but not prominently, vertex roundingly produced above each antenna. Antennæ compact, with branches closely flattened, equaling the distance from the inside of one eye to the outside of the other, or subequaling the length of the elytra. Maxillæ and palpi subequal; the maxilla from a side view, obliquely truncate beneath, and thicker than the palpus; palpus slightly tapering, rounded at apex. Mandibles short, acute, slightly curved, not much longer than first joint of palpi. Pronotum narrow, bandlike; mesonotum subequal and similar. Metanotum very long; præscutum keystone shape; scuti elongate subtriangular with apices at posterior angles of præscutum distant; scutellum subequal to præscutum in size and shape but inverted, with broadest side apical; postlumbium transverse semielliptical; femoralia short; postscutellum linear elongate, over twice as long as broad, with apices squarely rounded. Genitalia consisting of tenth segment overlapping the troughlike cavity of the ninth segment, which is bounded by the flaplike edges of the last ventral segment and apically terminated by a short œdeagus. In the type specimen the œdeagus is not reflexed and shielded by the tenth segment, but is directed backward. The sinuation is slight until about the posterior one-fifth, where the tube is abruptly turned downward. The apex is abruptly acute.

Type.—Two males, Cat. No. 9827, U.S.N.M.

Named in honor of Mr. E. A. Schwarz, from whose collection it is described.

4. Subfamily CRAWFORDINÆ Pierce, 1908.

Type genus.—*Crawfordia* Pierce (1908).

Maxillæ three-jointed, apparently; postlumbium as large as in *Stylops*, *Halictoxenos*, and *Apractelytra*, thus linking the bee-parasite genera; œdeagus very different from that of the three genera mentioned.

The subfamily includes one genus: *Crawfordia* Pierce, parasitic on *Panurginus;* America.

23. Genus CRAWFORDIA Pierce (1908).

Type of genus.—Crawfordia pulvinipes Pierce, 1904.

Dedicated to the honor of J. C. Crawford, who captured the type species and thus first interested the writer in this group of insects.

This genus is confined to North America. The hosts belong to the genus *Panurginus* in the Panurgidæ.

It is characterized by the peculiar shaped œdeagus which, arising at the apex of the abdomen, quickly dilates from a slender tube into a bent inflated vesicle, which again suddenly narrows into a very acute curved process.

The genus has the xenid characters of four-jointed antennæ, and four-jointed tarsi, but has apparently three-jointed maxillæ.

Key to females.

In the genus *Crawfordia* the female cephalothorax is very different from that of *Stylops,* so that the comparative ratios will be considerably different. The measurements are with 160 tube, 2-inch eyepiece, A objective, Zeiss stand, 1 space = 0.0076 mm.

Species.	1. Length.	2. Spiracle to apex.	3. Breadth between mandibles.	4. Breadth head.	5. Breadth at spiracles.	6. Greatest breadth.
cockerelli	92	60	27	80	85	87
pulvinipes	81	50	19	85	88	88

From these figures the following ratios, which are derived as in the discussion of *Stylops,* are obtained:

Species.	Cephalothorax to mandibles. (5):(3)::—:1.	Head to mandibles. (4):(3):—:1.	Cephalothorax to head. (5):(4):—:1.	Breadth to length. (5):(2):—:1.
cockerelli	3.14	2.96	1.06	1.41
pulvinipes	4.63	4.47	1.03	1.76

1. CRAWFORDIA PULVINIPES Pierce (1904).

Xenos pulvinipes Pierce, 1904.
Xenoides pulvinipes Pierce, 1905, in correspondence.
Crawfordia pulvinipes Pierce, 1908.

Host.—Panurginus, new species; West Point, Nebraska, August 10; collected by J. C. Crawford, in whose honor the genus is named. Types in writer's collection (pl. 12, fig. 7; pl. 13, figs. 4, 5*a*, 5*b*, 6, 7).

Male.—Antennæ four-jointed; first and second joints externally obliquely truncate, emarginate, for the reception of the following joint, very short; third joint with stem as short as preceding joints but elongated anteriorly into a very long, ribbon-like lamella which twists around the fourth joint; fourth joint surpassing third by length of stem of first three; third and fourth joints very slightly inflated, thickly covered with very fine hairs and very closely provided with large sensory pores. Eyes globular; lenses few, large, and separated by slightly raised, densely pubescent partitions. The mandibles are transparent yellow lancet-shaped appendages, curved slightly at the base, toothed near the tip, obliquely truncate and acute at tip. Almost obscuring the mandibles is a highly developed three-jointed appendage, with the first two joints subequal, semicylindrical, elbowed at each joint, and with the third an immense paddle-shaped sensitive lamella, fully as broad as the eyes, being broadest before the middle and thence narrowing to a rounded tip about one-third as wide, and measuring in length about the distance from the inner edge of one eye to the outer edge of the other. The prothorax is a mere band. The mesothorax is about double the length of the prothorax. The metathorax is typical. The lumbi of the scutum do not meet in the center and are somewhat elevated, with the interior margin rounded; the præscutum and the scutellum are distinctly separated, but together resemble a spindle; the postlumbium is shield-shaped, rounded behind, lower than the scutellum, rather concave, medianly longitudinally ridged, closely, finely punctate, yellowish; postscutellum long, narrow, surpassing the femoralia which cover the sides of the body and several abdominal segments. The thorax, with the exception of the postlumbium, is finely pubescent. Elytra short, narrow, apically thickened and rumpled into many ridges, thickly pubescent. Wings large, surpassing abdomen, consisting merely of the primary veins, costa, subcosta, radius, and media from the costal stalk and the first and second anal from the anal stalk; radius arises from subcosta; the second anal is not basally attached. Coxæ of first two pair of legs single-jointed, long; third pair with rather short coxæ, and a long trochanter. Femora and tibiæ longitudinally obliquely furrowed. Tarsi four-jointed, each joint inserted far before the apex of the preceding and with the apex sucker-like or pulvilliform. The abdomen is short and is mainly characterized by the peculiar œdeagus, which is immediately dilated at base, then turned and narrowed into a very acute curved process.

Female.—Length of cephalothorax 0.61 mm., breadth at spiracles 0.65 mm., breadth of head 0.57 mm., distance between mandibles 0.14 mm. Cephalothorax yellowish with dark brown band on base and base of abdomen, forming a collar; broad, subquadrate, constricted at base, broadest at spiracles, spiracles large convex, laterally prominent, placed obliquely; thence straight, slightly oblique, obtusely angled about anterior eighth and thence more oblique to mandibles, squarely and broadly truncate at apex; angles of head immediately in front of spiracles, from which a long oblique line extends to the anterior edge of the prothorax, just behind the mouth; mandibles triangular, with a sharp tooth at apex.

2. CRAWFORDIA COCKERELLI, new species.

Host.—*Panurginus ornatipes* Cresson (*boylei* Cockerell); Las Vegas, New Mexico, August 3; W. Porter, collector (pl. 12, fig. 8).

Female.—Length of cephalothorax 0.70 mm., breadth at spiracles 0.64 mm., breadth of head 0.608 mm., distance between mandibles 0.20 mm. Cephalothorax yellowish, with a dark brown basal band extending over upon abdomen and forming a collar; longer than broad, roundingly constructed at base, widest behind spiracles, spiracles lateral but not prominent, margin slightly convex, oblique to mandibles, squarely truncate at apex; mandibles large, blunt, placed on lateral strip of head; spiracles not large, convex.

Dedicated to Prof. T. D. A. Cockerell, of the University of Colorado, who has done so much toward the advancement of our knowledge of the Apoidea.

Type.—Cat. No. 10113, U.S.N.M.

Superfamily HALICTOPHAGOIDEA Pierce, 1908.

This superfamily includes two families; the Halictophagidæ and the Dioxoceridæ.

6. Family HALICTOPHAGIDÆ Pierce, 1908.

Strepsiptera or *Stylopidæ* (part) Hoeven, 1850.
Hymenopterobiæ (part) Saunders 1872.
Stylopides (part) Saunders, 1872.
Halictophaginæ Perkins, 1905.

Type genus.—*Halictophagus* Dale (Curtis, 1832).

Parasites of Tetigonidæ.

Antennæ seven-jointed, third to sixth produced laterally, seventh elongate; tarsi three-jointed.

This family includes five genera:

24. *Halictophagus* Dale (1832); hosts unknown; Europe.
25. *Pentacladocera* Pierce (1908), parasitic on *Agallia*?; Australia.
26. *Pentoxocera* Pierce (1908), parasitic on *Tetigonia*, *Hecalus*, *Paradorydium;* Australia.
27. *Agalliaphagus* Pierce (1908), parasitic on *Agallia;* America.
28. *Megalechthrus* Perkins (1905), parasitic on *Platybrachys;* Australia.
29. *Neocholax* Pierce, parasite on fulgorid; Java.
30. *Anthericomma* Pierce (1908); hosts unknown; America.

24. Genus HALICTOPHAGUS Dale (Curtis, 1832).

Halictophagus Dale MS.—Hoeven, 1850.—Saunders, 1872.

Type of genus.—*Halictophagus curtisii* Dale (Curtis, 1832).

Name derived from *Halictus* (the supposed host) + φαγεῖν (to eat), meaning erroneously that the genus is parasitic on *Halictus*.

The hosts are undoubtedly homopterous, but have not been discovered.

The genus is the type of the family Halictophagidæ. It has seven-jointed antennæ, the third to sixth joints being laterally produced, and the seventh subequaling the sixth. Tarsi triarticulate. Prothorax and mesothorax normal, ring like. Wings with seven primary veins and with a short vein beyond the radius, another detached but apparently arising from the medius, and a short vein arising just below the medius.

1. HALICTOPHAGUS CURTISII Dale (Curtis, 1832).

Halictophagus curtisii Saunders, 1872.

The host of this species is unknown, although it has been ascribed to *Halictus aeratus* Kirby, which was found stylopized in the vicinity where the male was collected. The species occurs in the adult male form in August at Lulworth Cove, England, on a rock called Durdle Door, and was originally taken by Mr. Dale by brushing some long coarse grass and thistles close to the sea.

Length 1.4 mm., expanse of wings 3.8 mm.

The following description of this species was published by Curtis in 1832:

> Black and slightly glossy, clothed with a brown velvety pubescence; antennæ and legs dull brownish ochre; wings slightly tinged with fuscous ochre and obscurely iridescent; nervures brown; tips of the joints of the tarsi and apex of abdomen ochreous. (Curtis, 1832.) Head broader than the thorax. Eyes very remote, prominent and coarsely granulated. Prothorax and mesothorax short, the latter with a pseudelytron attached on each side; they are very slender at the base and terminated by an ovate club. Metathorax somewhat scutate, the anterior portion forming three nearly equal lobes, the scutellum being short and rounded. Postscutellum very long tongue-shaped and thick, with a long deep groove at the base. Wings large, minutely punctured, rounded at the apex, with the costa thickened, a subcostal and five other strong longitudinal nervures and a callous stripe at the apex, the second nervure apparently a detached branch of the third, which has a short ray near the base of the second. Abdomen rather short, a great portion concealed by the postscutellum, composed of about eight joints, terminated by an obtuse process. (Anterior trochanters long.) Thighs rather short. Tibiæ short and compressed. Tarsi triarticulate, basal joint stout in the anterior pair, the second long and slender, third small obovate; nearly of equal length in the posterior pair, the apex of each joint produced beneath and submembranous or fleshy. Claws none.

The female is unknown.

25. Genus PENTACLADOCERA Pierce (1908).

?*Halictophagus* PERKINS, 1905.

Name derived from *πέντε* (five) + *κλάδος* (branch) + *κέρας* (horn), meaning five-branched antennæ.

Type of genus.—Pentacladocera schwarzii Perkins (1905).

The genus is parasitic upon *Agallia* or a nearly related bythoscopid genus and is at present confined to Australia.

This genus differs from *Pentoxocera* in that the five apical joints of the antennæ are not all of thin laminate form throughout, but the basal ones of these are of more normal form, and the branches are less thinly laminate. Palpi more slender than in *Pentoxocera*. The general form of the metathorax, tarsi, and genital segment as in *Pentoxocera*.

Differs from *Halictophagus* Curtis (according to Westwood) in that the metathorax is very different, as also is the terminal abdominal segment. Intermediate between *Halictophagus* and *Pentoxocera* in antennæ.

1. PENTACLADOCERA SCHWARZII Perkins (1905).

Halictophagus ? schwarzii PERKINS, 1905.
Pentacladocera schwarzii PIERCE, 1908.

Host.—Agallia (?), species; Mittatong, New South Wales (pl. 13, figs. 13, 14).

Male.—Expanse 3 mm. Black, clothed with extremely delicate sericeous pubescence, which is cinereous in some parts; the extreme tip of the abdomen testaceous; metathorax more or less obscurely pale in some parts, at least along the sutures. Antennæ blackish, third and fourth joint short, subtriangular, with one of the apical angles produced into a long branch, fifth and sixth joints shorter than the preceding, more ring-like, but produced into similar branches; seventh joint lamellate throughout. Wings subhyaline, slightly smoky and iridescent, the nervures very distinct blackish.

26. Genus PENTOXOCERA Pierce (1908.)

Halictophagus, subgenus *Bruesia* PERKINS, 1905 (preoccupied).

Name derived from *πέντε* (five) + *ὄζος* (branch) + *κέρας* (horn), meaning five-branched antennæ.

Type of genus.—Pentoxocera australensis Perkins, 1905.

The genus is typically parasitic on the genus *Tetigonia*, although at present parasites of *Hecalus* and *Paradorydium* are included. It is limited in our knowledge to the Orient. It contains at present four species:

1. *australensis* Perkins, 1905, parasitic on *Tetigonia parthaon* Kirkaldy; Queensland.

?2. *phæodes* Perkins, 1905, parasitic on *Hecalus immaculatus* Kirkaldy; Queensland.

?3. *stenodes* Perkins, 1905, parasitic on *Paradorydium menalus* Kirkaldy; Queensland.

?4. *schwarzi* Pierce, 1909, parasitic on *Diedrocephala sanguinolenta* Coquibar, Guatemala.

The following description is taken from Perkins:

Male.—Head very deeply concave behind, seen from above consisting only of a narrow rim supporting the eyes, and produced considerably in front of these to form the tip of the blunt and wide frontal projection, at the sides of which the antennæ are inserted. That which appears to be the tip of the head on superficial inspection is in reality the dorsum of the pro- and meso-thorax, which in their natural position are deeply immersed within the posterior concavity of the head, which they more or less fill up. Antennæ with the two basal joints simple, the following excessively short, being produced laterally into an elongate and thin lamina, the first and fifth (or last) of these laminæ being larger than the others and capable of inclosing them in a fan-like fashion. Mandibles very short compared with those of other Stylopids, their tips not reaching one another, simply pointed. Labial palpi very large, the second joint foliaceous half as wide as long, pilose, subacuminate at the apex. Scutellar portion of the metanotum moderately large, penetrating somewhat between the lateral lobes of its anterior portion, triangular, and very different from the small semilunar scutellum of *Elenchus;* the postscutellum very elongate, twice as long as wide, or appearing still longer in dry specimens, covering several of the basal abdominal segments. Elytra clavate or ladle-shaped in well-preserved specimens. Wings smoky hyaline, neuration black, very distinct. Tibiæ dilated apically, and grooved or hollowed above for the partial reception of the three-jointed tarsi, when these are drawn up. (Perkins, 1905.)

1. PENTOXOCERA AUSTRALENSIS Perkins (1905).

Halictophagus (*Bruesia*) *australensis* PERKINS, 1905, 1906.
Pentoxocera australensis PIERCE, 1908.

Host.—*Tetigonia parthaon* Kirkaldy, Cairns; Queensland (pl. 13, figs. 8, 9, 10, 11, 12).

Length about ⅓ mm. Expanse about 4 mm.

Perkins has described this species as follows:

Male.—Black or blackish fuscous, the thorax paler, piceous or brownish, the lamellate joints of the antennæ also paler, yellowish or sordid testaceous. Wings smoky hyaline, with slight but evident iridescence, the neuration strong, black. Apical abdominal segment with its genital process concave above and much produced, towards the base with an upright tongue-shaped, pilose organ; in lateral view the sides are slightly convergent to the apex, which is armed with a recurved hook, the tip of which is itself bent upward; in front of the origin of this uncus the process has a small deep emargination. The apical ventral segment is triangular and produced at the apex. The abdomen is clothed with delicate cinereous pubescence.

Female.—Length about ⅓ mm. Head yellow or brownish yellow, distinctly rounded at the sides, with a distinct anterior median area (or plate) marked out, and slightly produced; tuberculate on either side of this area in front. The opening of the brood chamber is behind the middle of the exposed part of the head, the surface between this opening and the apex subconvex. (Perkins, 1905.)

?2. PENTOXOCERA PHÆODES Perkins (1905.)

Halictophagus (*Bruesia*) *phaeodes* PERKINS, 1905, 1906.
Pentoxocera phaeodes PIERCE, 1908.

Host.—*Hecalus immaculatus* Kirkaldy, Cairns; Queensland.

This species has been described by Perkins as follows:

Female.—Length about ¼ mm. Head broader than long, brown, more yellowish in front and darker behind the opening of the brood chamber, strongly rounded at the sides, the anterior median area defined and slightly produced, tuberculate on either side of this area in front; the surface slightly convex between the opening of the brood chamber and the apex. (Perkins, 1905.)

?3. PENTOXOCERA STENODES Perkins (1905).

Halictophagus (*Bruesia*) *stenodes* PERKINS, 1905, 1906.
Pentoxocera stenodes PIERCE, 1908.

Host.—*Paradorydium menalus* Kirkaldy, Cairns; Queensland.

According to Perkins this species may be described as follows:

Female.—Length about ¼ mm. Head narrow, subelongate, sides not strongly rounded, more parallel-sided, piceous, shining opening of the brood-chamber near the middle of the head, the surface slightly convex. Otherwise agreeing generally with the preceding, *P. phæodes* (Perkins, 1905).

?4. PENTOXOCERA SCHWARZI, new species.

Host.—*Diedrocephala sanguinolenta* Coquibar; Cacao, Finca Trece Aguas, Alta Vera Paz, Guatemala, March, 1906; E. A. Schwarz and H. S. Barber (pl. 14, fig. 11).

Male.—Cephalotheca: Transverse diameter 0.65 mm., longitudinal diameter 0.49 mm.; yellowish brown, broad elliptic; pharyngeal orifice central, opening behind an inferior concave ridge, and bounded superiad by a more concave vertigial ridge; antennal analogues lateral, distant, prominent; vertex straight from eye to eye except in front of pharynx as described above; mandibular analogues immediately below vertex, prominent, chitinized brown, very close to lateral edges of pharyngeal orifice; maxillary analogues elliptic, oblique, reaching mandibles above, with a small prominent circular area at lower end.

Type.—Cat. No. 12316, U.S.N.M.

Named in honor of Mr. E. A. Schwarz, and placed provisionally in this genus.

27. Genus AGALLIAPHAGUS Pierce (1908).

Halictophagus (?) PERKINS, 1905.

Type of genus.—*Agalliaphagus americanus* Perkins, 1905.

The genus is parasitic on the bythoscopid genus *Agallia* and is at present limited to North America.

Name derived from *Agallia* (the host genus) + φαγεῖν (to eat), meaning parasitic on *Agallia.*

The location of the genus is uncertain although it undoubtedly belongs in the Halictophagidæ with the other jassid parasites.

1. AGALLIAPHAGUS AMERICANUS Perkins (1905).

Halictophagus (?) *americanus* PERKINS, 1905.
Agalliaphagus americanus PIERCE, 1908.

Host.—Agallia 4-notata; Columbus, Ohio.

This species was described by Perkins as follows:

> *Female.*—Length about ⅙ mm. Dark brown or piceous, suboblong, the anterior median area distinct in apical view, but generally hardly visible in surface view, owing to its portion on the apex of the head, which is bent at an angle to the outer surface, tuberculate on either side of this area; the whole disk of the head deeply impressed so as to form a great cavity leading into the opening of the brood-chamber (Perkins, 1905).

28. Genus MEGALECHTHRUS Perkins (1905).

Name derived from μεγάλη (large) + ἐχθρός (enemy) = large parasite.

Type of genus.—Megalechthrus tryoni Perkins (1905).

The genus is parasitic on the genus *Platybrachys* or an allied genus.

Male antennæ 7-jointed, five being foliaceous.

Female.—Head ovate, moderately elongate, the opening of the brood-chamber near the middle or rather in front of it, the small anterior median area distinct, a little produced in front, and tuberculate on either side of this area in front. This large form appears to be allied to *Pentoxocera* and *Pentacladocera,* but is, as Perkins thinks, distinct generically from these, by its long, ovate form and great size.

1. MEGALECHTHRUS TRYONI Perkins (1905).

Host.—Platybrachys (?), species, Cairns; Queensland.

Female.—Head ovate, moderately elongate, yellow or brownish yellow, shining when clean, but often dull from the excrement of its host, more strongly convex behind the orifice of the brood-chamber than in front of it.

Male.—Puparium brown or pitchy, unicolorous or nearly so. Length about ⅔ mm.

29. NEOCHOLAX, new genus.

Name derived from νέος (new) + χόλαξ (parasite), meaning a new and interesting parasite.

Antennæ 7-jointed, the third, fourth, fifth, and sixth branched beneath, the basal part of the third elongate as in *Pentacladocera.* Mandibles short and acute. Palpi with first joint short, cylindrical, one-third as long as second, obliquely truncate at apex; second joint borne on apical truncation of the preceding, elongate, tapering, sensitive. Prothorax anteriorly convex, fitting into excavation of head. Wings as in *Pentoxocera*.

Type of genus.—*Halictophagus jacobsoni* Meijere 1908. The genus is typically parasitic on Fulgoridæ and at present is confined to Java.

1. NEOCHOLAX JACOBSONI Meijere (1908).

Halictophagus jacobsoni MEIJERE, 1908.

Parasitic on a fulgorid, Semarang, Java, June and July, 1905, Edw. Jacobson (pl. 14, figs. 1, 2, 3, 4).

Male.—Head dark brown; antennæ brown, somewhat transparent, the rami of decreasing lengths, the last joint scarcely longer than the branch of the preceding, as in *Pentacladocera schwarzi*. Mandibles brown. Thorax and abdomen grayish brown, the thorax brighter. Prothorax strongly arched forward. Head emarginate at base. Tibiæ brown; tarsi brighter, golden. Elytra dark brown. Length 1.3 mm., wing length 1 mm.; antennal length 0.4 mm.; length of branch of third antennal joint 0.26 mm., the last antennal joint 0.16 mm.; breadth of head 0.52 mm.; length of palpus 0.14 mm.

Female.—Cephalothorax golden brown, behind the opening of the brood canal dark brown, scarcely broader than long (0.28 mm.); sides rounded, head convex, behind the protuberant parts a small darker median stripe.

Triungulinid.—Similar to that of *Pentoxocera*, sides almost parallel, the whole appearance somewhat oval. Length 0.13–0.16 mm.; breadth 0.06 mm.; length of bristle of last segment 0.09 mm., or more than half as long as the body. On the venter of the next to last segment are three pairs of bristles, of which the middle pair are shortest, the next longer, and the outer pair still longer; each ventral segment bearing on apical margin three short hairs arranged in longitudinal rows. Eye-spot with five pigment lenses arranged in a cross.

Male puparium.—The diameters of the cephalotheca are 0.5 mm. × 0.4 mm.[a]

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[a] *Male.*—Kopf schwarzbraun, Fühler braun, etwas durchsichtig, die Anhänge in abnehmender Länge, das letzte Glied kaum etwas länger als der Anhang des vorletzten, also wie bei *H.* (*Pentacladocera*) *schwarzii* Perk. gebildet. Taster braun. Thorax und Hinterleib graubraun, der Thorax an den Nähten heller. Prothorax in der Mitte mässig vorgebuchtet, Kopf hinten im oberen Teile ausgehöhlt. Beine braun, Tarsen heller, gelblich. Elytren schwarzbraun. Flügelgestalt und Geäder wie in fig. 3, 3te Hauptader also einfach. Körperlänge 1.3 mm.; Flügellänge 1 mm.; Länge der Fühler 0.4 mm. Länge des Anhangs des 3ten Fühlergliedes 0.26 mm., des letzten Fühlergliedes 0.16 mm. Breite des Kopfes 0.52 mm. Länge des letzten Tastergliedes 0.14 mm.

Female.—Kopf gelbbraun, hinter dem Querspalt dunkelbraun, kaum etwas breiter als lang (ca. 0.28 mm.), die Seiten abgerundet, der vor der Quernaht liegende Teil convex. Hinter dem heraustretenden Teil kein dunkler Medianstreifen.

Triungulinid.—Die winzigen Larven stimmen sehr mit den bei Perkins abgebildeten von *Bruesia* (*Pentoxocera*) überein, sie sind bald parallelseitig, bald von mehr

30. Genus ANTHERICOMMA Pierce (1908).

Name derived from ἀνθέριξ (stalk) + ὄμμα (eye) = stalked eye.

Type of genus.—Anthericomma barberi Pierce.

This genus is confined to America. Hosts unknown.

The genus is characterized by having the pronotum and prosternum confined to median disks, surrounded on three sides by the mesothorax, which is laterally contiguous to the head. The antennæ are seven-jointed, with the last five joints flabellate of graduated length, making the apical slightly the shortest. The tarsi are three-jointed.

1. ANTHERICOMMA BARBERI Pierce (1908).

Halictophagus barberi Pierce, 1905, in determinations.

Host.—Unknown; Santa Fe, New Mexico.

Male, collected by H. S. Barber, in whose honor it is named, May 6, 1904 (fig. 3, Nos. 13, 14; pl. 14, figs. 5, 6, 7, 8).

Male.—"Length 1.25 mm.; including wings folded, 2 mm. Species stout, compact, with very large wings. General color black, wings milky white" (Pierce, 1908). Head transverse, closely and coarsely punctate, eyes stalked, facets close, round, and bordered by few hairs. Antennæ transparent grayish with darker pubescence, the last five joints outwardly flattened, foliaceous, and covered with a very sensitive surface. Maxillæ two-jointed, pubescent. Mandibles short, pubescent. Gula transverse, striate. "Pronotum obovate, disk-like, not connected with prosternum, projecting about equally into emarginations of the head and mesothorax, medianly depressed longitudinally and transversely. Mesonotum transverse, anteriorly broadly emarginate for the admission of the pronotum; transversely depressed near apical margin. Metanotum very long" (Pierce, 1908). Præscutum long, wider at base than apex; scutum elongate linear, with oblique ridge to apical corners of præscutum; scutellum with base and sides rounded and apex transversely truncate; postlumbium linear transverse, very short; postscutellum as long as all the anterior portions of the thorax; femoralia reaching posteriorly one-third the

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ovaler Gestalt, ihre Länge beträgt 0.13–0.16 mm., die Breite 0.06 mm., die Borsten des letzten (10ten Ringes) sind 0.09 mm., also etwas länger als die halbe Körperlänge; ferner fallen noch an der Ventralseite des vorletzten Ringes 3 paar Börstchen auf, von welchen das mittlere Paar äusserst klein, das darauf folgende etwas grösser ist, während das äussere Paar, welches nahe dem Seitenrande liegt, bei weitem am meisten vorragt; die Borsten desselben sind 0.02 mm. lang. Im übrigen finden sich an der Unterseite des Abdomens am Hinterrande der Segmente noch einige in 3 Reihen (einer medianen und 2 seitlichen) angeordnete, äusserst winzige, dornartige Fortsätze. Jede Seite des Kopfes zeigt einen fast runden schwarzen Pigmentfleck, welcher 5 Linsen trägt, von welchen die 3 vorderen etwas grösser sind als die 2 hinteren. Die Linsen sind in einem Kreis angeordnet. Unmittelbar hinter dem Fleck fängt der Prothorax an.

Male puparium.—Der vorspringende Teil des männlichen Pupariums ist 0.45 mm. lang, der Deckel desselben misst 0.5 × 0.4 mm. (Meijere, 1908).

length of the postscutellum. The wings are very long, milky white, and pubescent. The legs are very small and do not appear fit for use. The prosternum is a mere rounded, oblong disk not connected with propleuræ, which are lacking; consisting only of the two coxæ; trochanters elongate, longitudinal, contiguous throughout, and flattened anteriorly; femora and tibiæ subequal, black, tarsus very small and inconspicuous. Mesosternum as mesonotum, adjacent to head, except in space occupied by the anterior coxæ; coxæ not contiguous, placed just outside of the anterior coxæ; femora a little longer than the tibiæ; tarsi three-jointed normal. Posterior legs longer than the median and proportioned about the same except that the trochanters are shorter. The last two pairs of legs silky pubescent, pulvilli yellow. The genitalia could not be seen in this specimen.

Type.—Cat. No. 9829, U.S.N.M.

7. Family DIOXOCERIDÆ Pierce, 1908.

Type-genus.—*Dioxocera* Pierce, parasitic on *Xerophlœa*, a gyponine genus, which is distributed over North America and the West Indies.

The family is characterized by the three-jointed tarsi, and four-jointed antennæ, with the third and fourth antennal joints laterally produced as in the Xenidæ.

31. Genus DIOXOCERA Pierce (1908).

Type-species.—*Dioxocera insularum* Pierce, which is parasitic on *Xerophlœa viridis* Fabricius. The genus is confined to North America.

Name derived from *δύο* (*δι*–) (two) + *ὄζος* (branch) + *κέρας* (horn) = two-branched antennæ.

Male.—Defined by family characterization.

Male puparium.—Cephalotheca transverse obovate. Pharyngeal area divided from occipital area by straight transverse side lines and an arched median vertex. The three analogues on each side not separated from one another by distances greater than the diameter of the antennal analogue, and placed in a straight line.

Female.—Cephalothorax subquadrate, with sides rounded, mandibles apical and prominent, pharyngeal orifice subapical; transverse slit behind the middle, straight in median half, but deeply retreating at sides. Dorsally the chitinous portion ceases at a broadly curving line directly above the ventral slit. At this point the body is enlarged to fit the interior of the host.

The ratio of breadth at spiracles, that is, at the corner of the ventral slit, to the distance between the mandibles is as 3.15 : 1. The ratio of breadth at spiracles to distance from spiracles to apex is as 1.4 : 1.

1. DIOXOCERA INSULARUM Pierce (1908).

Type.—Male and two females, collected at Fort St. George, Grenada, West Indies.

Cotypes.—One female collected at Grand Ance, Grenada; one female, one male pupa collected on St. Vincent, West Indies.

Host.—*Xerophlœa viridis* Fabricius (fig. 3, Nos. 11*a*, 11*b*, 12; pl. 14, figs. 9, 10).

Male.—Dark brown. Thorax normal. On account of the imperfect condition of the specimen, which was extracted from a puparium, the remaining parts can not at present be defined.

Male puparium.—Cephalotheca transverse obovate; yellowish brown, sparsely minutely punctate. Eyes occupying one-quarter of median line on each side, sparsely punctate to correspond with ommatidia. Median transverse line limiting anterior edge of pharyngeal area passes straight from eyes to the arched vertex. Antennal analogues distant from eyes by less than their diameter, and from median transverse line by less than one-third their diameter; irregularly rounded with four concentric rings, the inner of which is covered with little tubercles. Mandibular analogues distant from eyes by about their breadth and from the median transverse line by the same distance as the antennal analogues; not or hardly longer than broad, bilobed at apex, the inner lobe an acute tooth. Pharyngeal orifice equidistant from vertex and mandibular analogues by its own breadth. Maxillary analogues not as distinct as antennal, indicated by a small circle with a larger indistinct concentric circle. Oral analogues all on a lighter-colored bilobed area, between the lobes of which a darker area extends from the ventral base to the pharyngeal orifice.

Female.—Cephalothorax light reddish brown; length 0.238 mm.; breadth at base of head 0.273 mm. Apex broadly subtruncate arched in front of mouth, with mandibles prominent at sides of truncation. Mandibles broad, interiorly armed with an acute outward pointing tooth, and exteriorly obtusely angled, thus resembling the mandibles on the male puparial cephalotheca.

Type.—Cat. No. 12315, U.S.N.M.

Superfamily ELENCHOIDEA Pierce, 1908.

This superfamily includes only one family, the Elenchidæ.

8. Family ELENCHIDÆ Pierce, 1908.

Strepsiptera or *Stylopidæ* (part) HOEVEN, 1850.
Hymenopterobiæ (part) SAUNDERS, 1872.
Stylopides (part) SAUNDERS, 1872.
Homopterobiæ SAUNDERS, 1872.
Elenchinæ PERKINS, 1905.

Type-genus.—*Elenchus* Curtis (1831).

Parasitic on Fulgoroidea.

Antennæ five-jointed, the third laterally produced, the fourth and fifth elongate; tarsi two-jointed.

The family includes six genera:

32. *Elenchus* Curtis (1831), parasitic on *Liburnia;* Europe.
33. *Elenchoides* Pierce, parasitic on *Perkinsiella;* Fiji Islands.
34. *Mecynocera* Pierce (1908), parasitic on *Liburnia;* America.
35. *Pentagrammaphila* Pierce, parasitic on *Pentagramma;* America.
36. *Deinelenchus* Perkins (1905), parasitic on *Platybrachys;* Australia.
37. *Colacina* Westwood (1877), parasitic on *Epora;* Asia.

32. Genus ELENCHUS Curtis (1831).

Elenchus Hoeven, 1850.—Saunders, 1872.

Name derived from ἔλεγχος (anything pending), referring possibly to the resemblance of the elytra to pendants.

Type of genus.—*Elenchus walkeri* Curtis (1829).

The genus is parasitic on insects of the fulgorid genus *Liburnia,* and in the present broad sense occurs in Europe, Asia, and America.

This genus is typical of the family *Elenchidæ,* having the antennæ 5-jointed, the first two short, cup-shaped, the third laterally produced as a long flat appendage, the fourth elongate flattened, the fifth flattened double the size of the fourth and exceeding the apex of the third. The tarsi are two-jointed. The wing venation consists of a very short costa with a strong subcosta and radius on the costal margin, a detached outer vein between these and the medius, a long medial vein with several small basal veins or folds on either side of it, and one long anal vein.

1. ELENCHUS WALKERI Curtis (1829).

Stylops walkeri Curtis, 1829.
Elenchus walkeri Curtis, 1831.—Westwood, 1835 *b*, 1840.—Saunders, 1872.

Host.—Unknown.

Localities.—Southgate and Dorset, England; Belfast, Ireland; June, July.

Male.—Length, 1.2 mm.; expanse of wings, 3.4 mm.

The following description is revised from that originally furnished by Curtis in 1831.

Dull ochreous-fuscous; eyes black and shining; wings iridescent, pale fuscous, costa and nervures darker fuscous; legs and antennæ pubescent (Curtis, 1831). Head short, producing an obtuse lobe in front and a smaller one on each side. Eyes remote, lateral, globose, composed of about twenty hexagons. Prothorax short. Mesothorax longer, with pseudelytron attached on each side, exceeding in length the breadth of the mesothorax, clavate, slender toward the base. Metathorax large and oblong, divided diagonally into four portions, the scutellum being the smallest.

Postscutellum elongate ovate. Wings large, rounded at the apex, punctured and pubescent, with the costa thickened, a few imperfect nervures below it, and a long one running parallel to the interior margin. Abdomen slender, composed of nine or ten joints, as long as the trunk but incurved. Legs long, hinder pair remote. Coxæ (trochanters), anterior and intermediate very long, hinder short. Thighs and tibiæ nearly of equal length, the four anterior long slender and curved, the posterior short, and broad toward the apex. Tarsi composed of two joints, slenderest in the first pair; basal joint forming a lobe beneath, and hollow above to receive the second, which is subclavate (removed from description of genus, Curtis, 1831).

Mr. A. H. Haliday swept two males from herbage near Belfast, Ireland, which may prove to be different from the typical species. His manuscript notes are interesting and of importance, so are copied in part from Curtis (1831).

They are as follows:

It seems very delicate; the only specimen I could succeed in bringing home alive I put under a watch glass, but having to leave it for an hour I found it dead, though in a cool spot. It moved with a vacillating but tolerably rapid gait with the upper wings extended and the lower rapidly vibrating, the abdomen, with which it smooths its wings, twisting freely in all directions. The antennæ are kept apart with the branches divaricated, and the longer one generally bent in an angle at the articulation; the palpi? (maxillæ) mostly in motion. All the membranous parts are capable of much dilation and contraction, and are fully expanded when in lively motion, but contract after death. The wings were cinereous with blacker nervures. Abdomen longer than the rest of the trunk, fleshy, of eight segments besides the anal one bearing the appendage. The first three are softer, more extensile and versatile than the rest, which have a single row of transverse spots down the back, one on each segment, of stronger consistence and darker color; also a series of more minute ones down the belly. The color of the membranous parts is cinereous yellow, the horny plates of a darker blackish cinereous shade; the ovipositor (œdeagus), tibiæ, and base of antennæ nearly black, eyes deep black.

Female.—Unknown.

2. ELENCHUS TENUICORNIS Kirby (1815).

Stylops tenuicornis KIRBY, 1815.
Elenchus tenuicornis S. S. SAUNDERS, 1872.—E. SAUNDERS, 1892 *a*, *b*.

Host.—*Liburnia*, species; England, August 20.

Male.—Black; eyes subsessile; antennæ very elongate, piceous, rami linear, wings dark. Length about ½ line.[a]

3. ELENCHUS TEMPLETONII Westwood (1835).

Elenchus TEMPLETON, 1838.
Elenchus templetonii SAUNDERS, 1872.

Host.—Unknown, Mauritius, August (pl. 15, fig. 1).

Male.—Fuscous; thorax strongly gibbous; eyes large, black; abdominal segments constricted; fifth joint of antennæ subclavate and narrowed slightly at middle; elytra clavate, blackish toward apex; wings very broad, pale fuscous, veins obscure; tarsi as in *Elenchus walkeri;* legs and antennæ very finely pubescent. Length $\frac{2}{3}$ line; wing expanse 1 line.[a]

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[a] *Male.*—Aterrimus, oculis subsessilibus, antennis tenuioribus piceis, ramis linearibus, alis nigricantibus. Long. corp. ½ lin. circiter. In Mus. Brit. (Saunders 1872, p. 32).

33. ELENCHOIDES, new genus.

Type of genus.—Elenchoides perkinsi Pierce.

Parasitic upon the fulgorid genus *Perkinsiella* and confined to the islands of the Pacific Ocean.

The male cephalotheca is almost round and is characterized by having the mandibular analogues much more nearly approximate than the antennal or pupal analogues, the distance between the mandibles being one-quarter of that between the pupal or antennal analogues.

The female has only three genital canals entering the brood canal, which begins with the fifth segment. The opening of the latter is semicircular, with a narrow curtain extending forward. The spiracles are at the sides of the base of the head and opening of the brood canal. The head is broadly cordiform, more angulate at apex than in *Mecynocera kœbelei.* The single pair of lobes or analogues are approximate, but not contiguous, as in *Mecynocera.*

The male larva has prominent mouth parts, the labrum being distinct, ellipsoidal; mandibles blunt, not approximate; maxillæ apparently three jointed, with two minute appendages on the third joint, and subquadrate.

The description is drawn from the figures by Muir (1906).

1. ELENCHOIDES PERKINSI, new species.

Elenchus tenuicornis MUIR, 1906, not KIRBY, 1815, not PERKINS, 1906.

Host.—Perkinsiella vitiensis Kirby; Fiji (pl. 15, fig. 6).

It is very evident from the figures that this species is not identical with the American *Mecynocera kœbelei,* which Perkins referred to as *Elenchus tenuicornis* Kirby. In fact, it is probable that they have still another species parasitic on *Aloha ipomoeæ* in Hawaii, which has also been given the same determination.

In the absence of specimens, the species must remain defined by the host, habitat, and by the drawings published by Muir.

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[a] Fuscus, thorace valde gibboso, oculis magnis nigris, segmentis abdominalibus constrictis, antennarum articulo 5to subclavato et in medio subangustato, articulum referente; elytris clavatis nigricantibus versus apicem; alis latissimis pallidis fuscescentibus, nervis obscurioribus; tarsis ut in *El. walkeri,* Curt. formatis; pedibus antennisque pube tenuissimâ indutis. Long. corp. $\frac{2}{3}$ lin.; expans. alarum fere lin. 1 (Westwood, 1835 *b*).

34. Genus MECYNOCERA Pierce (1908).

Type of genus.—*Mecynocera kœbelei* Pierce.

Name derived from μηκύνω (=elongate) + κέρας (=horn), referring to the elongate antennæ, which are characteristic of the Elenchidæ. This genus is confined to North America. The hosts belong to the genus *Liburnia*, Homoptera, Fulgoridæ.

It differs from *Elenchus* principally by having the ninth dorsal segment of the abdomen obliquely truncate from the dorsal median base to the ventral apex, and terminated by the reflexed œdeogus, which is shallowly siphonated or sinuate. The maxillæ are feebly two-jointed, the first joint bearing about its middle a filiform process with a knobbed apex, reaching the tip of the second joint of the maxillæ.

1. MECYNOCERA KŒBELEI Pierce (1908).

Elenchus tenuicornis Perkins, 1905, not Kirby, 1815.

Host.—*Liburnia campestris, Liburnia lutulenta;* Columbus, Ohio, female, August 17; males, August 11; collected by Mr. A. Koebele while endeavoring to find parasites of fulgorids for introduction into Hawaii, and named in his honor (fig. 3, nos. 15, 16; pl. 15, figs. 2, 3, 4, 5).

Male.—Length, 1 mm.; wing expanse, 2 mm. Slender, frail, yellowish. This insect is a typical elenchid, although typifying a new genus closely related to *Elenchus.* The antennæ are five-jointed, tæniæform; the first two joints more or less cylindrical; third, laterally produced into a long ribbon-like appendage with strongly sensitized surfaces; the fourth leaving the third at a distance from its base less than the length of the third; fifth joint flattened as the two preceding, separated from the fourth in the same plane by a transverse constriction and extending beyond the tip of the third by one-half its length. The surface of the antennæ is typical. The tubercles, however, are not as closely guarded as in *Acroschismus.* Antennæ very nearly as long as thorax. Eyes with comparatively few hairs and with the lenses close. Maxillæ feebly bilobed with a chitinous filament from the middle of the first segment. Mandibles short, stout, acute. Prothorax a mere band, and mesothorax double. Elytra, clavate, with a long peduncle; club paddle-shaped, with sensitive surface. Wings delicate hyaline. The veining consists of five primary veins, the first and second costal and subcostal, the third radial, and the fourth medial; fifth anal with a short unattached vein between the radius and medius. Tarsal joints two, the second arising considerably before the apex of the first. Trochanters of the first two pairs of legs very long, as long or longer than the femora. Femora of posterior leg nearly three times as long as trochanters and about twice as long as coxæ; coxæ depressed for reception of trochanters at apex; trochanters curved, socket-shaped; femora cylindrical, enlarging apically, obliquely truncate, and grooved for the reception of the tibiæ, which are much smaller in diameter at all points than the femora; tibiæ enlarged gradually toward apex, but not equaling length of coxæ and trochanters. Tarsi not as long as tibiæ. The ninth segment occupies about a third the length of the abdomen. From the anal extremity the œdeagus is reflexed forward, slightly sinuate, with apex turned upward, and is protected laterally by two high flexible flaps, which are contiguous at their upper anterior corners and graduate obliquely to the base of the genital tube. The tenth segment is somewhat obscure in the concavity of the ninth. The œdeagus is glabrous, hyaline yellow, abruptly tapering and acute at the apex; the lateral flaps are very pubescent. The wing venation differs from that of the typical *Elenchus*, as does also the metathoracic scutellum.

Female.—The female is very different from the xenid type. No sign of mandibles can be found. The head composes the greater part of the disk with the oral aperture marginal. The thorax seems to be sunken into the abdomen, with an immense opening to the brood canal.

According to Perkins it is described as follows:

> Head brownish or pitchy, opening of the brood chamber far behind the middle and very large, no anterior median area and tubercles defined, but with a faint round spot just in front of the brood-chamber orifice on each side of the middle line. Length, ⅙ mm. (Perkins, 1905.)

Type.—Cat. No. 9028, U.S.N.M.

35. PENTAGRAMMAPHILA, new genus.

Type of genus.—*Pentagrammaphila uhleri* Pierce.

This genus is typically American and parasitic on the genus *Pentagramma.*

1. PENTAGRAMMAPHILA UHLERI, new species.

Female.—Length of cephalothorax 0.35 mm., breadth at spiracles 0.38 mm., breadth at base of head 0.34, distance between mandibles 0.098 mm. Cephalothorax; reddish-brown subquadrate, spiracles at basal angles, sides oblique, apex truncate with rounded lobe in front of mouth; spiracles not prominent; head occupying one-half the length of the cephalothorax; mandibles elongate oblique, obtuse.

Type.—Cat. No. 12317, U.S.N.M.

Named in honor of Dr. P. R. Uhler, in whose collection were found *Pentagramma vittatifrons* Uhler, collected by Rothauer in "Dacota," in which this species was taken. The locality "Dacota" includes North and South Dakota, Wyoming, Montana, and probably part of Idaho, so it is not very definite.

36. Genus DEINELENCHUS Perkins (1905).

Name derived from *δεινός* (powerful) + *Elenchus*, meaning very large Elenchid.

Type-species.—Deinelenchus australensis Perkins.

Parasitic on *Platybrachys*, limited to Australia.

The original description was as follows:

> *Male.*—Like *Elenchus* in most respects, e. g., in the structure of the tarsi and antennæ, but very much larger, and with the second antennal joint, seen from above, very short and transverse, the basal one elongate. Frontal process much blunter and less prominent than in *Elenchus*. As in that genus, the face is deeply excavated, but it is much more open, not triangular, but with the sharp edge of the front and sides forming a great semicircle, or rather more. The palpi are two-jointed sparsely pilose, the second joint narrower than the first and in the form of a curved blade. The postscutellum of the metathorax is longer than in *Elenchus*.
>
> *Female.*—Head nearly circular, very wide, the anterior margin simply and widely rounded, with no defined anterior median area, and without evident tubercles in front. Between the openings of the brood-chamber and the anterior margin there are two distinct areas marked out by impressed lines, which run backward to the brood-chamber orifice as deep grooves on either side of a smooth slightly raised tubercle. Opening of the brood-chamber bisecting the head in surface view. Allied to *Elenchus* by the absence of a definite anterior median area and the presence of those on the disk, between the anterior margin of the head and the orifice of the brood-chamber (Perkins, 1905).

1. DEINELENCHUS AUSTRALENSIS Perkins (1905).

Host.—Platybrachys, species, Cairns; Queensland.

Perkins described this species as follows:

> *Male.*—Piceous, perhaps blacker in mature specimens; the sides and the scutellum of the metathorax pale, its anterior lobe and postscutellum dark. Legs with the femora pale, the tibiæ dark, fuscous. Elytra for the most part blackish, the wings quite smoky, with a slight iridescence, neuration black. Expanse probably about 4.5–5 mm.
>
> *Female.*—Head brownish in front of and yellow behind the brood-chamber orifice. The discal areas between the latter and the apical margin somewhat fan-shaped, and themselves divided by very fine grooves. Sometimes in apical view of the head two round faint spots can be seen, but there is no definite median area nor tubercles. Length and breadth each about $\frac{2}{3}$ mm.
>
> Male puparium dark brown with a pale ring at the base of its protruded portion (Perkins, 1905).

37. Genus COLACINA Westwood (1877).

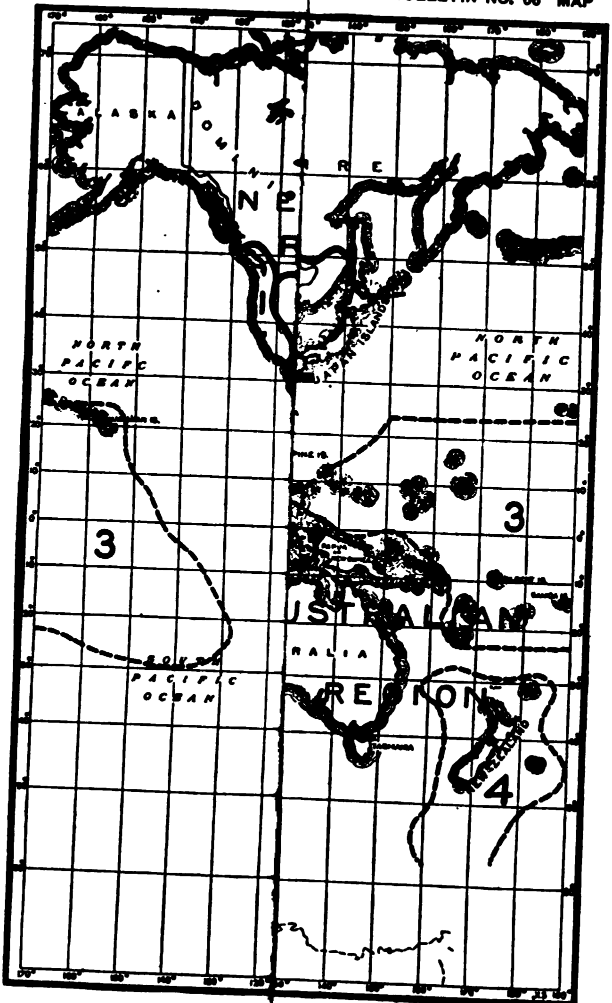
Type of genus.—Colacina insidiator Westwood (1877).

Name derived from *κόλαϛ* (parasite).

The genus is parasitic on Fulgoridæ of the genus *Epora*, and at present is restricted to the Malayan regions.

On *Colacina* Saunders (1872) based his group Homopterobiæ. The location of the genus is uncertain, although it is probably allied to the other fulgorid parasites, which are all elenchids.

U. S. NATIONAL MUSEUM BULLETIN NO. 66 MAP



The generic description will have to be drawn from the specific description which follows. The ventral surface of the male is appressed to the dorsum of the host.

1. COLACINA INSIDIATOR Westwood (1877).

Host.—*Epora subtilis* Walker (1857), a fulgorid insect, from Sarawak, Borneo (pl. 15, fig. 7).

Male puparium.—Cephalotheca subquadrate; eye covers at sides, large and somewhat lunate; antennal analogues in form of two rounded spaces, adjacent to eyes and distant from each other by over their diameter, partially covered with minute granules; antennal analogues connected by transverse impression; two small transverse pieces below antennal analogues represent the mandibular analogues, while the two small swollen spaces which follow these indicate the maxillary analogues.

GEOGRAPHICAL DISTRIBUTION OF THE STREPSIPTERA.

This subject has been somewhat difficult to handle owing to the fact that only a little over a hundred species are known, but yet some satisfaction has been obtained by studying the records of insects parasitized, from the geographical standpoint. It is found that there are fifty genera of insects in four orders, and fourteen families, which are known to be attacked by the Strepsiptera, from only 25 of which genera have specimens of parasites been described. In the 50 genera of hosts, 238 species are known to be parasitized, and it is first on the basis of these host insects that the following discussion is founded.

As a basis for the study of zoogeography there are two excellent works, one by Wallace (1876) and the other by Heilprin (1886), each of which contains a map of the zoogeographic regions of the world. The regions defined by Wallace are accepted by the writer as best adapted to show the distribution of the Strepsiptera. It is, however, well to first draw a few conclusions from Heilprin's standpoint.

According to the latter author the Strepsiptera as now known would be classed as primarily Holarctic; that is, native to North America and Eurasia, north of the Himalayas. They are entirely absent or unknown from Heilprin's first division of this realm, which extends through Canada, northern Europe, and Siberia. This would therefore define them as belonging only to the temperate and tropical regions.

According to Wallace there are six primary realms which he conveniently divides into four regions each. His Nearctic realm comprises all of North America, except a greater part of Mexico. The Palæarctic realm includes Eurasia, except Arabia south of the

Tropic of Cancer, India, Siam, and southern China, and also includes Africa north of the Tropic of Cancer. The Ethiopian realm includes Africa and Arabia south of the Tropic of Cancer. The Oriental realm includes India, Siam, Burma, southern China, Sumatra, Java, Borneo, and the Philippines. The Australian realm includes the remainder of Malaysia, Melanesia, Polynesia, Australia, and New Zealand. A map is presented herewith to show the delimitation of the subdivisions.

Taking the host records as the only available criterion, it is found that the parasitized species are distributed as follows: Nearctic 90, Palæarctic 91 (Holarctic of Heilprin, excluding Mediterranean fauna, 162), Neotropical 19, Ethiopian 3, Oriental 14, and Australian 23. It is probable that the low number for the tropical realms is due to the fact that less collecting has been done, for it seems likely that the tropical fauna should be most prolific in such forms.

The following tables present the distribution of the known 238 species of host insects and show that the order is indeed world-wide, yet not because of cosmopolitan host insects. The only regions from which no hosts have been recorded are the boreal, the west central African, Madagascar, and New Zealand. Only 13 of the 50 genera are found parasitized in two or more realms. These genera are distributed as follows:

Polistes in 5 realms and 9 regions; *Sceliphron* in 4 realms and 6 regions; *Sphex* in 4 realms and 6 regions; *Proterosphex* in 3 realms and 5 regions; *Liburnia* in 3 realms and 4 regions; *Vespa* in 3 realms and 3 regions; *Andrena* in 2 realms and 5 regions; *Eumenes* in 2 realms and 2 regions; *Odynerus* in 2 realms and 2 regions; *Ancistrocerus* in 2 realms and 2 regions; *Parasphex* in 2 realms and 2 regions; *Priononyx* in 2 realms and 2 regions; *Halictus* in 3 realms and 3 regions.

Only five of these genera are both Nearctic and Palæarctic with regards to stylopization, namely, *Liburnia*, *Polistes*, *Sphex*, *Andrena*, and *Halictus*.

Table of the Distribution of Stylopized Genera.

Genus.	Nearctic.				Neotropical.				Palæarctic.				Ethiopian.				Oriental.				Australian.			
	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.
Gryllotalpa	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...
Tetigonia	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...
Diedrocephala	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Xerophlœa	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Deltocephalus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Eutettix	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Hecalus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Paradorydium	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Phlepsius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Agallia	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Perkinsiella	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
Megamelanus	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Liburnia	...	...	3	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...
Pentagramma	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hadeodelphax	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Aloha	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
Platybrachys	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...
Epora	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...
Chrysocoris	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...
Paragia	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...
Eumenes	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...
Rygchium	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Monobia	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Odynerus	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ancistrocerus	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Leionotus	...	1	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hoplomerus	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Psiloglossa	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Vespa	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	3	...	...	...	...	...
Polistes	1	4	14	...	...	1	1	...	1	2	...	...	...	...	1	...	2	...	...	...	...	...	...	...
Polybia	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Belonogaster	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Icaria	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...
Sceliphron	...	...	1	...	1	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	3	1	...	...
Proterosphex	...	...	3	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...
Isodontia	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Chlorion	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Parasphex	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...
Priononyx	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sphex	...	1	5	...	...	...	...	...	1	2	...	...	1	...	...	...	...	1	...	...	...	...	...	...
Miscus	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Stizomorphus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Bembecinus	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bembex	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Prosopis	...	...	...	...	...	...	...	...	1	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Halictus	...	...	6	...	...	...	...	...	12	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...
Andrena	6	6	26	...	...	...	...	...	49	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Panurginus	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Halictoides	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Melitturga	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

APPENDICES.

PARASITISM.

Certain characteristics or laws of parasitism may be framed as a general summary of the results found in the article.

I. The fact that a certain peculiarity is possessed by two insects in varying degrees does not indicate close relationship.

(1) The abortion, or loss of wings, occurs in Coleoptera, Diptera, Strepsiptera, Dermaptera, Homoptera, Orthoptera, and Hymenoptera.

(2) The wingless female occurs in Coleoptera, Lepidoptera, Strepsiptera, Hymenoptera, and Homoptera.

(3) The "raspberry" eye occurs in Diptera (Pupipara), Strepsiptera, and Thysanoptera.

(4) Hypermetamorphosis occurs in Coleoptera, Neuroptera, Hymenoptera, and Strepsiptera.

(5) Larviparous reproduction occurs in Homoptera, Strepsiptera, and Diptera.

(6) Flabellate antennæ occur in Coleoptera, Strepsiptera, and Hymenoptera.

II. Two lines of descent may arise from greatly variant sources and through the assumption of similar habits of life develop organs closely approximating each other. Or two different combinations of causes may exert influences inducing an approximation of resultant organs.

(1) The Meloidæ, Rhipiphoridæ, and Strepsiptera have the first larval stages similar.

(2) The antennæ of the Rhipiphoridæ are flabellate, as they are also in male Strepsiptera.

(3) The mouth parts of the Rhipiphoridæ and Strepsiptera are atrophied. The peculiar rhipiphorid *Rhyzostylops inquirendus* Silvestri may be referred to in this connection.

III. Parasitism is an acquired habit; an adaptation—hence a specialization. In the specialized adaptation to a parasitic life certain organs become unnecessary and are changed to accomplish new functions or become aborted or lost. Certain other organs at the same time have an increase of function or assume duties entirely new, and consequently through selection and modification induced by changed functions become very different from the type organs.

(1) In the Strepsiptera the first change noted is the loss of legs and eyes by the larva, and the ultimate recovery of these organs by the male, but the final loss of them by the female.

(2) The reduction of the male front wings to clubs is accompanied by the assumption of the function of sound making.

(3) The female's permanence in one position has brought about the complete reduction of all appendages except the mandibles

which are used in pushing out the cephalothorax, and perhaps aid in the act of copulation. The necessity of being inconspicuous on the host's body, or rather the necessity of preventing a drying up of the host's interior, has reduced the cephalothorax to a flattened disk which hardly raises the abdominal plates of the host.

IV. A parasite may by constant reduction of parts become exceedingly simple in structure; in other words, generalized. This is, however, generalization by reversion, and is by no means indicative of primitiveness.

V. Hypermetamorphosis is the extreme of known specialization in development of insects.

(1) The appearance of the hexapod larva resembling the most primitive of adult insects, followed by successive stages representing various types of larvæ, then succeeded by an internally formed pupa, which remains inclosed in its larval skin, and finally the resultant highly specialized male, seems to carry the insect through all of the evolutionary stages experienced in the production of specialized insects. In fact, hypermetamorphosis rehearses the stages of evolution.

VI. Larviparous reproduction is a modification of biology due to specialization of activities.

(1) The female strepsipteran never leaves its host, and therefore oviposition is impossible.

VII. The differing habits of the hosts have given rise to the isolation of species of parasites, and their dependence upon a single species of host for nourishment is the result of specialization to meet the requirements of life in that host.

VIII. A single host may in different localities have different species of parasites in the same genus or group.

HABITS OF LARVÆ OF INSECTS.

The following generalized table is planned to show the progression of dependence in insect larvæ, leading to parasitism. It is, in fact, designed mainly to show that the nature of the parasitism by the Strepsiptera is different from that of any other group of insect. Leading examples only are given. (Acarina are included for comparative purposes.)

a. Eggs deposited:	
aa. The egg placed promiscuously	1.
ab. The egg placed regularly away from larval food	3.
ac. The egg placed in or on the larval food	4.
(Tachinidæ)	4*b*.
b. Eggs not deposited:	
ba. Larvæ issuing in presence of food—	
(Sarcophagidæ)	4*b*, 4*c*.
(Aphididæ)	4*a*.
(Tachinidæ)	4*b*.

bb. Larvæ issuing away from food—
(Strepsiptera) ....
(Tachinidæ) .... } 3*b*.
bc. Larvæ nourished by parent and issuing ready for pupation; adults parasitic on warm-blooded animals: Pupipara.
bd. Offspring issuing as adults; adults parasitic on insects: *Pediculoides*.

1. Larvæ omnivorous, predaceous, and scavengers (precocious), as, for example, Blattoidea, Mantoidea, etc. (*aa*).
Larvæ feeding on decaying matter, scavengers (*aa*)........................2.
2. Adults not parasitic: Dermestidæ, other Coleoptera, Diptera (1*b*).
Adults parasitic on warm-blooded animals: Suctoria (1*b*).
3. Larvæ generally vegetation feeders; eggs laid in ground (precocious), as, for example, Acridoidea (*ab*).
Larvæ after first stage parasitic and reliant upon carriers or search to find hosts:
Meloidæ, Rhipiphoridæ (*ab*)..4.
Strepsiptera (*bb*)..4.
Ixodoidea (*ab*)..4.
Tachinidæ (*ab*, *bb*)..4.
4. Larvæ phytophagous (*ac*, *ba*)..5.
Larvæ zoophagous (*ac*, *ba*, 3*b*)..7.
Larvæ scavengers: Sarcophagidæ (*ba*).
5. Larvæ capable of finding food after immediately surrounding supply is exhausted (precocious): Homoptera, including some Aphididæ (*ba*), Chrysomelidæ, Lepidoptera, Tenthredinidæ, *Phytonomus* (4*a*).
Larvæ dependent upon immediate surroundings for food supply: Rhynchophora, Bruchidæ, etc. (4*a*).
Larvæ dependent upon other insects (4*a*, *ba*)..6.
6. Larvæ dependent upon insects of their own species for nourishment (altricious): Isoptera, Formicoidea, Vespoidea, Apoidea (5*c*).
Larvæ dependent upon insects of other species for attention: Aphididæ (*ba*), Coccidæ, Aleurodidæ (5*c*) (frequently attended or distributed by ants).
7. Larvæ dependent upon insects of their own species for stored food: Sphecoidea, Bembecidæ (4*b*).
Larvæ receiving their food at the expense of warm-blooded animals (4*b*)......8.
Larvæ receiving their food at the expense of other insects (4*b*, 3*b*).............9.
8. Larvæ externally parasitic upon warm-blooded animals: Ixodoidea, Mallophaga, Parasitica (7*b*).
Larvæ internally parasitic in warm-blooded animals: Oestridæ (7*b*).
9. Larvæ feeding upon food stored for other insects (commensals) (7*c*): termitophila, myrmecophila.
Larvæ feeding upon other insects (7*c*)..10.
10. Larvæ feeding externally upon host (ectozoic) (9*b*)........................11.
Larvæ feeding internally upon host (endozoic) (9*b*)........................12.
11. Larvæ compelled to seek or be carried to host: Rhipiphoridæ, Meloidæ (10*a*, 3*b*).
Larvæ hatching in reach of host: Ichneumonidea, Chalcidoidea (10*a*).
12. Pupation outside of dead host: Sarcophagidæ (*ba*), Ichneumonoidea, Chalcidoidea (10*b*).
Pupation within the skin of dead host: Tachinidæ, Ichneumonidæ (10*b*).
Pupation within host, female never leaving host, which matures and does not die until the progeny of the parasite are distributed: Strepsiptera (10*b*, *bb*).

Although this table makes no attempt to comprehend all the various types of metamorphosis in insects, it is believed that it shows satisfactorily that the Strepsiptera represent the nearest approach to true permanent parasitism that is to be found in insects.

HOST LIST.

ORTHOPTERA.

Superfamily GRYLLOIDEA.

Family GRYLLOTALPIDÆ.

Gryllotalpa Latreille.
  species, Vituland, East Africa (Voeltzkow, 1880, pp. 441-5).

HOMOPTERA.

The classification follows Kirkaldy.[a]

Superfamily CICADOIDEA.

Family TETIGONIIDÆ = JASSOIDEA Authors.

Tribe TETIGONIINI.

Tetigonia Geoffroy (*Tettigonia* Authors).
  albida, Australia, *Pentoxocera*, species (Perkins, 1905).
  parthaon Kirkaldy, Cairns, Queensland, (male, female); *Pentoxocera* (*Bruesia*) *australensis* Perkins (Perkins, 1905, 1906).
Oncometopia Stal.
  lateralis Fabricius, Nogales, Arizona (A. Koebele), (male) (Perkins, 1907).
Diedrocephala Spinola.
  sanguinolenta Coquibar, Cacao, Finca Trece Aguas, near Senaju, Alta Vera Paz, Guatemala, March (Schwarz and Barber); (puparium) *Pentoxocera schwarzi* Pierce.

Tribe PENTHIMIINI.

Xerophloea Germar.
  viridis Fabricius, St. Vincent, West Indies; Grand Ance (South End); Fort St. George, Grenada, West Indies (H. H. Smith), (puparia, females); *Dioxocera insularum* Pierce.

Tribe PHRYNOMORPHINI.

Deltocephalus Burmeister.
  ?species, Australia (Perkins, 1906).
Eutettix Van Duzee.
  species, Australia (Perkins, 1906).
Hecalus Stal.
  immaculatus Kirkaldy, Cairns, Queensland; (female) *Pentoxocera* (*Bruesia*) *phæodes* Perkins (Perkins, 1905, 1906).

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[a] Hawaiian Sugar Planter's Experiment Station, 1907.

Tribe CEPHALELINI.

Paradorydium Kirkaldy.
menalus Kirkaldy, Cairns, Queensland; *Pentoxocera* (*Bruesia*) *stenodes* Perkins (Perkins, 1905, 1906).

Tribe ATHYSANINI.

Phlepsius Fieber.
species, Australia (Perkins, 1905).

Tribe EURYMELINI=BYTHOSCOPIDÆ Authors.

Agallia Curtis.
quadrinotata, Columbus, Ohio; *Agalliaphagus* (*Halictophagus?*) *americanus* Perkins (Perkins, 1905).
?species, Mittatong, New South Wales; *Pentacladocera* (*Halictophagus?*) *schwarzii* Perkins (Perkins, 1905).
Ceratagallia Kirkaldy.
bigeloviæ Baker, Nogales, Arizona (A. Koebele), (Perkins, 1907).
species, Australia (Perkins, 1905).

Superfamily FULGOROIDEA.

Family ASIRACIDÆ.

Perkinsiella Kirkaldy.
vitiensis Kirkaldy, Fiji; *Elenchoides perkinsi* Pierce (*Elenchus tenuicornis* Muir), (Muir, 1906, p. 6).
species, Fiji, *Elenchus* ?, species (Perkins, 1905, p. 93).
Megamelanus Ball.
species, Bay Ridge, Maryland, September 1 (Otto Heidemann).
Stobæra Stal.
species, Nogales, Arizona (A. Koebele), (Perkins, 1907).
Liburnia Stal.
brevipennis Boheman, Horsens, Denmark, September 25 (female); Ruderhegen, Denmark, March 9 (puparium); *Elenchus*, species (Meinert, 1896 *b*).
campestris Van Duzee, Columbus, Ohio, August 11 (males), August 17 (female); *Mecynocera koebelei* Pierce (collection U. S. National Museum).
lutulenta Van Duzee.
1. Columbus, Ohio, August 11 (male); *Mecynocera koebelei* Pierce (*tenuicornis* Perkins), (Perkins, 1905; collection U. S. National Museum).
2. Alameda, California (Perkins, 1905).

species, Surbiton, England, August 20 (male); *Elenchus tenuicornis* Kirby, (E. Saunders, 1892 *a*).
species, Queensland; (*Elenchus tenuicornis* Perkins), (Perkins, 1905).
species, Bay Ridge, Maryland, September 1 (Otto Heidemann).

Pentagramma Van Duzee.

vittatifrons Uhler, "Dacota" (Rothauer), (females); *Pentagrammaphila uhleri* Pierce (collection P. R. Uhler, U. S. National Museum).

Hadeodelphax Kirkaldy.

species, Australia (?) (*Elenchus tenuicornis* Perkins), (Perkins, 1906).

Aloha, Kirkaldy.

ipomoeæ Kirkaldy, Mount Tantalus (1,300 feet), Hawaii (W. M. Giffard); (*Elenchus tenuicornis* Muir) ?, (Muir, 1906, p. 6).

Family ISSIDÆ.

Subfamily EURYBRACHYINÆ.

Platybrachys Stal.

species, Cairns, Queensland; *Deinelenchus australensis* Perkins (Perkins, 1905).

? species, Cairns, Queensland; *Megalechthrus tryoni* Perkins (Perkins).

Family POEKILLOPTERIDÆ.

Subfamily TROPIDUCHINÆ.

Tribe TROPIDUCHINI.

Epora Walker

subtilis Walker, Sarawak (puparium); *Colacina insidiator* Westwood (Westwood, 1877).

Location doubtful.

species, Semarang, Java, June, July (E. Jacobson), (male, female); *Neocholax jacobsoni* Meijere (Meijere, 1908).

species, Honolulu, Hawaii; *Elenchus* species (Perkins, 1906, in letter).

HETEROPTERA.

Family PENTATOMIDÆ.

Subfamily SCUTELLARINÆ.

Chrysocoris Hahn. (*Callidea* Burmeister).

grandis baro Fabricius, East Asia (female), (Sharp, 1899, p. 303; Perkins, 1905).

HYMENOPTERA.

Superfamily FORMICOIDEA.

Family FORMICIDÆ.

—————, species, Ramboddo, Ceylon, April 29; *Myrmecolax nietneri* Westwood (Westwood, 1861).

Superfamily VESPOIDEA.

Family MASARIDÆ.

Paragia Shuckard.
  decipiens Shuckard, Australia (exuvium), (Smith, 1867).
  tricolor Smith, Australia (female), (S. S. Saunders, 1872).

Family EUMENIDÆ.

Eumenes Latreille.
  fenestralis Saussure, (female), (L. von Heyden, 1867).
  maxillosa DeGeer (*tinctor* Christ) (female), (L. von Heyden, 1867).
  petiolata Fabricius, India (female, exuvium), (Smith, 1859).
  pomiformis Fabricius, Nicaea (puparium), (S. S. Saunders, 1872).
  tinctor Christ = *maxillosa* DeGeer.
Rygchium Spinola (*Rhynchium* Billberg).
  flavomarginatum Smith, Brazil (exuvium), (Smith, 1859).
Monobia Saussure.
  quadridens Linnæus, Wolfe City, Texas, May 31 (female); Orange, Louisiana, August 23 (females), (F. C. Bishopp); *Monobiaphila bishoppi* Pierce (collection U. S. Cotton Boll Weevil Investigation).
Odynerus Latreille.
  chloroticus, Spinola, (female), (L. von Heyden, 1867).
  deflendus Saunders, Epirus; Corcyra (male); *Pseudoxenos heydenii* Saunders (S. S. Saunders, 1853).
  species, Brazil (exuvium), (Smith, 1859).
Ancistrocerus Wesmael (*Odynerus* Latreille, part).
  campestris Saussure, Missouri (C. V. Riley), (exuvium), collection U. S. National Museum).
  parietum Linnæus, Corcyra (male); *Pseudoxenos schaumi* Saunders (S. S. Saunders, 1872).
Leionotus Saussure (*Odynerus* Latreille, part).
  annulatus Say, Dallas, Texas, July 31, on *Helenium tenuifolium* (W. A. Hooker), (female), (collection U. S. Cotton Boll Weevil Investigation).
  colon Cresson, Mound, Louisiana, May 12 (C. R. Jones), (female); *Leionotoxenos jonesi* Pierce (collection U. S. Cotton Boll Weevil Investigation).
  foraminatus Saussure, Cincinnati, Ohio, August 10 (female), (Dury, 1902; collection C. Dury).
  pertinax Saussure, National Park, Wyoming, July 31 (male), (collection U. S. National Museum).

vagans Saussure, Mound, Louisiana, May 12 (C. R. Jones), (female); *Leionotoxenos louisianae* Pierce (collection U. S. Cotton Boll Weevil Investigation).

verus Cresson, Dallas, Texas, July 21, on *Helenium tenuifolium* (W. A. Hooker), (female); *Leionotoxenos hookeri* Pierce (collection U. S. Cotton Boll Weevil Investigation). Triungulinids of this parasite were found on an *Agapostemon texanus* taken at the same flower species.

Hoplomerus Westwood (*Odynerus* Latreille, part).

lævipes Shuckard, Epirus (male); *Pseudoxenos klugii* Saunders (S. S. Saunders, 1872).

spinipes Linnæus, Corcyra (males); *Pseudoxenos? (Paraxenos) corcyricus* Saunders (S. S. Saunders, 1872).

Psiloglossa Saunders.

odyneroides Saunders, Epirus (exuvium), (S. S. Saunders, 1872).

Family VESPIDÆ.

Vespa Linnæus.

concolor Kirby (exuvium), (Kirby, 1813).

crabro Linnæus, Japan (female); *Vespæxenos crabronis* Pierce (C. F. Baker collection, U. S. National Museum).

ducalis Smith, Huē, Annam (male); *Vespæxenos buyssoni* Pierce (Buysson, 1906).

lama Buysson, Sikkim, India; altitude 12,500 feet (female) (Buysson, 1905).

magnifica Smith, Yun-nam and Tsé-kou, China (females); *Vespæxenos (Xenos) moutoni* Buysson, 1903).

mandarina Smith, Ngan-hoei and Yng-chan, China (females); *Vespæxenos (Xenos) moutoni* Buysson (Buysson, 1903).

nigra Buysson, Yun-nam and Tsé-kou, China (females); *Vespæxenos (Xenos) moutoni* Buysson (Buysson, 1903).

vulgaris Linnæus, Stuttgart, Germany (female), (Roser, 1836).

Polistes Latreille.

americanus Fabricius = *crinitus* Felt.

annularis Linnæus.

1. Austin, Texas, May (males); *Acroschismus (Xenos) pallidus* Brues, 1903).
2. Paris, Texas, July–October (males, females); *Acroschismus (Xenos) pallidus* Brues; *A. (X) nigrescens* Brues (Brues, 1905).
3. Paxton (Shelby County), Texas, August 9 (W. D. Pierce), (female).
4. Rosser, Texas, September, October (F. C. Bishopp, C. R. Jones), (males, females); *Acroschismus pallidus* Brues (collection U. S. Cotton Boll Weevil Investigation).

5. Agricultural College, Mississippi (female), (from collection Mississippi Agricultural College).
6. Bennington, Indian Territory, August 28 (J. C. Crawford), (collection U. S. Cotton Boll Weevil Investigation).
7. Victoria, Texas, July 16 (W. E. Hinds), (females), (collection U. S. National Museum).
8. Texas (Belfrage), (puparia), (collection U. S. National Museum).
9. Plummer's Island, Maryland, November, 1907 (female, puparia); W. P. Hay, W. L. McAtee, collectors; *Acroschismus pallidus* Brues.

aurifer Saussure.

1. Washington State (exuvium); California (puparium), (collection Philadelphia Academy of Sciences).
2. Folsom, California, July 10, 12 (exuvia), (collection U. S. National Museum).

bellicosus? Cresson, Natchitoches, Louisiana, September 15 (female); (collection U. S. Cotton Boll Weevil Investigation).

canadensis Linnæus.

1. Texas (exuvium), (collection Philadelphia Academy of Sciences).
2. Mound, Louisiana, August 20 (F. C. Bishopp), (exuvium), (collection U. S. Cotton Boll Weevil Investigation).

carnifex Fabricius, Mexico (puparium, exuvium), (collection Philadelphia Academy of Sciences).

crinitus Felton (*americanus* Fabricius).

1. North America (exuvium), (Smith, 1859).
2. Crescent City, Florida (H. G. Hubbard), (males, females); *Acroschismus hubbardi* Pierce (Hubbard, 1892; collection U. S. National Museum).

diadema Latreille = *gallicus* Linnæus.

flavus Cresson, Colorado (puparium), (collection U. S. National Museum).

fuscatus Fabricius, Newbury, Massachusetts (male); *Schistosiphon* (*Xenos*) *peckii* Kirby (Kirby, 1813).

gallicus Linnæus.

1. France; Italy (male); *Xenos vesparum* Rossi (Rossi, 1790, 1793).
2. Geneva, Switzerland (male); *Xenos jurinei* Saunders (Jurine, 1818).
3. Cairo, Egypt (males, females); *Xenos vesparum* Rossi (Nassonow, 1893 *a*).
4. Europe (Rouget, 1873), Rosenhauer, 1842.
5. (*diadema* Latreille), (Rouget, 1873).

6. (*diadema* Latreille), Innsbruck, Austria, October 28 (Karl Hofeneder).

hebræus Fabricius, Northwest India (female), (Horne, 1871).

instabilis Saussure.

1. Brazil (female, exuvium), (Smith, 1859). This Polistes is either *crinitus* Fabricius or *fuscatus* Fabricius.
2. New Orleans, Louisiana, July (exuvium), (collection U. S. National Museum).

lineatus Fabricius, Cuba (Palmer and Riley), (puparium, exuvium), (collection U. S. National Museum).

marginalis Fabricius.

1. Boma, Ethiopia (Schulz, 1905).
2. *stigma* Fabricius, Northwest India (female), (Horne, 1871).

metricus Say.

1. Colebrook, Connecticut, August (W. M. Wheeler), (males, females); *Acroschismus wheeleri* Pierce (*Xenos peckii* Brues), (Brues, 1903).
2. Washington, District of Columbia, September 6 (males); *Acroschismus wheeleri* Pierce (collection U. S. National Museum).
3. Ithaca, New York, August, September (authority, F. C. Chittenden).
4. Detroit, Michigan (males, females); *Acroschismus bruesi* Pierce (collection U. S. National Museum).
5. Readville, Massachusetts (males, females), (Austin, 1882).
6. Chicopee, Massachusetts (F. Knab), (exuvia).

navajoe Cresson, Metacomba Key, Florida, March, 1898 (Collins and Pollard), (exuvium), (collection U. S. National Museum).

pallipes Lepeletier.

1. Marion, Massachusetts, September 2–12; *Acroschismus bowditchi* Pierce (Bowditch, 1902; collection F. C. Bowditch).
2. Cincinnati, Ohio, June 15 (puparia); July 3 (puparia); August 24, 25 (exuvia, puparia, female; September 13 (exuvia); September 16 (males, females); September 22 (male); *Acroschismus bowditchi* Pierce (Dury, 1902, 1906; collections C. Dury, Annette F. Braun, Cincinnati, Ohio).

perplexus Cresson, Texas (exuvium), (collection Philadelphia Academy of Sciences).

rubiginosus Lepeletier.

1. Austin, Texas (male); *Acroschismus* (*Xenos*) *nigrescens* Brues (Brues, 1903, 1905).

2. Round Mountain, Texas (exuvia, female), (collection Philadelphia Academy of Sciences).
3. Logansport, Louisiana, June 6 (W. D. Pierce), (puparium, females); *Acroschismus rubiginosi* Pierce (collection U. S. Cotton Boll Weevil Investigation).
4. New Boston, Texas, September 26 (F. C. Bishopp), (exuvia, puparia), (collection U. S. Cotton Boll Weevil Investigation).
5. Henrietta, Texas, October 5 (J. C. Crawford), (exuvium).
6. Mineola, Texas, July 19 (Bishopp and Jones), (exuvia), (collection U. S. Cotton Boll Weevil Investigation).
7. Waco, Texas, August 29 (F. C. Bishopp), (female, exuvia); *Acroschismus pecosensis* Pierce (collection U. S. Cotton Boll Weevil Investigation).
8. Onaga, Kansas (Crevecoeur), (exuvium).
9. Texas, *Acroschismus maximus* Pierce.

stigma Fabricius = *marginalis stigma* Fabricius.

texanus Cresson.

1. Austin, Texas (exuvia), (Brues, 1903).
2. Victoria, Texas, July 7 (C. M. Walker), (puparia); (collection U. S. Cotton Boll Weevil Investigation).
3. Pecos, Texas, February 27 (puparia, males); September 25 (females); September 30 (males), (A. E. Brown); *Acroschismus pecosensis* Pierce (Skinner, 1903, *a*, *b;* collection Philadelphia Academy of Sciences).
4. Victoria, Texas, July 25 (C. R. Jones), (female, exuvium); *Acroschismus texani* Pierce (collection U. S. Cotton Boll Weevil Investigation).
5. New Mexico (C. F. Baker; collection U. S. National Museum).

variatus Cresson.

1. Connecticut, *Xenos peckii* Brues (Brues, 1903).
2. Washington, District of Columbia (puparia), (authority F. C. Chittenden).

species, Caffraria (male), (S. S. Saunders, 1872).

species, Hat Creek (Sioux County), Nebraska, August (female, exuvia); *Xenos bruneri* Pierce (from collection University of Nebraska).

species, Virginia (male), (collection Philadelphia Academy of Sciences).

species, Victoria, Texas, June 27 (females), (C. R. Jones); September 25 (females, puparia), (J. C. Crawford); *Acroschismus hunteri* Pierce (collection U. S. Cotton Boll Weevil Investigation).

Polybia Lepeletier.
  sericea Olivier, Brazil (female), (Smith, 1859).
Belonogaster Saussure.
  grisea Fabricius.
    1. Africa (female), (S. S. Saunders, 1872).
    2. (*rufipennis* De Geer), Africa (female, exuvium), (S. S. Saunders, 1872).
  juncea Fabricius, Tripoli (female), (Smith, 1859).
  rufipennis De Geer = *grisea* Fabricius.
Icaria Saussure.
  ferruginea Fabricius, Northwest India (female), (Horne, 1871).

Superfamily SPHECOIDEA.

Family SPHECIDÆ.

Sceliphron Klug (*Pelopæus* Latreille).
  chiliensis Spinola = *Chlorion spinolæ* Smith.
  deformis Smith, Shanghai, China (female), (Smith, 1859).
  fasciatum Lepeletier.
    1. Chili (exuvium) (S. S. Saunders, 1872).
    2. Santo Domingo (female); *Sceliphronechthrus fasciati* Pierce (collection U. S. National Museum).
  flavo-fasciatum Smith, Celebes (exuvium), (S. S. Saunders, 1872).
  intrudens Smith, Celebes (female), (Smith, 1859).
  laboriosus Smith, Aru Island (female), (Smith, 1859).
  tibialis Fabricius (*Sphex tibialis* Fabricius), North America (exuvia), (S. S. Saunders, 1872).
  species, Australia (Perkins, 1905, 91).
Proterosphex Fernald (*Sphex* Authors). Synonymy according to Fernald (Proceedings U. S. National Museum, No. 1487).
  auriflus Perty = *ichneumoneus* Linnæus.
  aurocapilla Templeton = *ichneumoneus auriflus* Perty.
  caliginosus Erichson, Boqueti, Chiriqui, Panama (2,500 feet altitude), (Rosenberg), (exuvia), (C. F. Baker, collection U. S. National Museum).
  flavipes Smith = *flavitarsis* Fernald.
  flavitarsis Fernald (*flavipes* Smith), Georgia (exuvium), (Smith, 1859).
  ichneumoneus Linnæus.
    1. North America (males); new species larger by one-half than *Xenos peckii* (L. von Heyden, 1867).
    2. Cincinnati, Ohio, June 18 (female, puparia), (Dury, 1902; collection C. Dury, Cincinnati).

3. *aurifluus* Perty (*aurocapilla* Templeton), Brazil (male); *Homilops* (*Paraxenos*) *westwoodi* Templeton (Templeton 1838).
4. Waco Texas, August 29 (F. C. Bishopp), (females, exuvia); *Homilops bishoppi* Pierce (collection U. S. Cotton Boll Weevil Investigation).

pennsylvanicus Linnæus, det. Ashmead, Cincinnati, Ohio, August 12 (Annette F. Braun), (female, exuvium).

pernanus (?) Kohl, Santo Domingo (females, exuvium); *Homilops ashmeadi* Pierce (collection U. S. National Museum).

petiolata Smith = *Isodontia costipennis* Spinola.

tibialis Fabricius = *Sceliphron tibialis* Fabricius.

new species (female, exuvium), (S. S. Saunders, 1872).

species, Trong, Lower Siam (Dr. W. L. Abbot), (exuvia, female); *Homilops abbotti* Pierce (collection U. S. National Museum).

Isodontia Patton.

costipennis Spinola (*petiolata* Smith), Brazil (female), (Smith, 1859).

Chlorion Latreille.

spinolæ Smith (*Pelopæus chiliensis* Spinola), Chili (exuvium), (Smith, 1859).

Parasphex Smith.

albisecta Lepeletier, Epirus (female), (S. S. Saunders, 1872).

fervens Fabricius = *viduatus* Christ.

viduatus Christ (*fervens* Fabricius), India (female), (S. S. Saunders, 1872).

Priononyx Dahlbom.

atrata Lepeletier, Cincinnati, Ohio, June 17 (female); August 16, (male); August 19 (male); September 21 (puparium, female); *Ophthalmochlus duryi* Pierce (Dury, 1902; collections C. Dury, Annette F. Braun, Cincinnati, Ohio).

chiliensis Lepeletier, Chili (E. C. Reed), (male, exuvia); (C. F. Baker, collection U. S. National Museum.)

Sphex Linnæus (*Ammophila*, Authors).

atripes Smith, India (female), (S. S. Saunders, 1872).

capensis Lepeletier = *tydei* Guillon.

extremitatus Cresson, Cincinnati, Ohio, August 6 (female); August 30 (females, male); *Eupathocera lugubris* (?) Pierce (Dury, 1902; collection C. Dury).

ferrugineipes Lepeletier, Gambia (exuvium), (Smith, 1859).

fragilis Smith, Cincinnati, Ohio, September 3 (male); October 2 (exuvium); *Eupathocera lugubris* Pierce (collection C. Dury).

holosericea Fabricius, Sicily (females, exuvium), (Smith, 1859).

intercepta Lepeletier, Cincinnati, Ohio, August 25 (exuvium), (collection C. Dury).

procera Dahlbom (*gryphus* Smith, det. Dury), Cincinnati, Ohio, September (authority C. Dury).

pruinosa Cresson, Canyon City, Colorado, August; Denver, Colorado (J. S. Hunter), (female), *Eupathocera pruinosæ* Pierce.

sabulosa Linnæus, France, Germany (female); *Eupathocera?* (*Paraxenos*) *sphecidarum* Dufour (Dufour, 1837; Siebold, 1839).

tydei Guillon (*capensis* Lepeletier), Tunis (exuvium), (Smith, 1859).

varipes Cresson, Beulah, New Mexico, August 11 (exuvium), (Viereck, 1903; collection Philadelphia Academy of Sciences).

species, Milwaukee, Wisconsin (male), (S. Grænicher in letter).

Miscus Jurine.

campestris Latreille, Germany, *Eupathocera* (?) (*Paraxenos*) *sieboldii* Saunders (Siebold, 1839).

Family STIZIDÆ.

Stizomorphus Costa.

species (Perez, 1886).

species, Australia (Perkins, 1905, 91).

Family BEMBECIDÆ.

Bembecinus Costa.

peregrinus Smith, Corcyra; *Paraxenos erberi* Saunders (S. S. Saunders, 1872).

Bembex Fabricius.

species, Australia (Perkins, 1905, p. 91; 1906 in letter).

Superfamily APOIDEA.

Family PROSOPIDÆ.

Prosopis Fabricius.

bipunctata Fabricius, England (female), (S. S. Saunders, 1872).

gibba Saunders, Epirus (male, female); *Hylechthrus quercus* Saunders (S. S. Saunders, 1850).

rubicola Saunders.

1. Epirus (male, female); *Hylechthrus rubi* Saunders; *Hylechthrus rubi pustulatus* Saunders (S. S. Saunders, 1850).
2. (stylop) *versicolor* Saunders, Epirus (males); *Hylechthrus rubi* Saunders (S. S. Saunders, 1850).

signata Panzer = *bipunctata* Fabricius.

variegata Saunders, Epirus (female, exuvium); *Hylechthrus sieboldii* Saunders (S. S. Saunders, 1853).

Family ANDRENIDÆ, Authors.

Subfamily HALICTINÆ.

Halictus Latreille.

æratus Kirby, England (female), (Curtis, 1832). Curtis ascribed *Halictophagus curtisii* Dale to this host because he found it flying in the same locality as a parasitized bee.

albipennis Robertson (*Chloralictus*), Milwaukee, Wisconsin, August 4 (S. Grænicher), (females); *Halictoxenos grænicheri* Pierce.

?*albipes* Kirby.

1. England (Perkins, 1892).
2. (*obovatus* Kirby), England (S. S. Saunders, 1872).

bruneri Crawford (*Chloralictus*), West Point, Nebraska, June 10 (female); *Halictoxenos crawfordi* Pierce (from collection J. C. Crawford).

calceatus Scopoli (*cylindricus* Fabricius), England (Perkins, 1892).

cylindricus Fabricius = *calceatus* Scopoli.

longulus Smith, England (female), (Smith, 1859).

manilæ Ashmead, Manila, Philippine Islands (Robt. Brown), (female); *Halictoxenos manilæ* Pierce (collection U. S. National Museum).

minutissimus Kirby, England (Perkins, 1892).

minutus (Schrank) Lepeletier, England (female); *Halictostylops* (*Halictophagus*) *spencii* Nassonow (Smith, 1859; Nassonow, 1893 *a*, *b*).

morio Fabricius, England (Perkins, 1892).

nitidiusculus Kirby, England (female), (Smith, 1859).

obovatus Kirby = *albipes* Kirby.

quadrinotatus Kirby, England (female), (S. S. Saunders, 1872).

robbii Ashmead, Manila, Philippine Islands (female); *Halictoxenos robbii* Pierce (collection U. S. National Museum).

rubicundus Christ, England (female), (S. S. Saunders, 1872).

sparsus Robertson (*Chloralictus*), Ardmore, Oklahoma, March 12 (F. C. Bishopp), (female); *Halictoxenos sparsi* Pierce.

tumulorum Linnæus, England (female), (Perkins, 1892).

versatus Robertson (*Chloralictus*), Milwaukee, Wisconsin, September 1, 10, 22 (S. Grænicher), (females); *Halictoxenos versati* Pierce.

xanthopus Kirby, England (Perkins, 1905, 92).

zephyrus Smith (*Chloralictus*), Milwaukee, Wisconsin, September 12 (S. Grænicher), (female); *Halictoxenos zephyri* Pierce.

species, Selma, Alabama, October (W. H. Patton), (exuvium), (collection Philadelphia Academy of Sciences.)

species (*Chloralictus*), Logansport, Louisiana, June 7 (W. D. Pierce), (male); Mound, Louisiana, May 12 (C. R. Jones), (puparium); *Halictoxenos jonesi* Pierce (collection U. S. Cotton Boll Weevil Investigation).

Subfamily ANDRENINÆ.

Andrena Fabricius. The synonymy of species is according to Dalla Torre (1895), which brings the synonymy later than the "Catalogus."

advarians Viereck (types), Vancouver, British Columbia, March 26, April 5 (females); *Stylops advarians* Pierce.

æneiventris Morawitz (Perez, 1886).

afzeliella Kirby.

1. (First generation) England, France (females), (Pickering, 1835; Smith, 1875; Perez, 1886; Alfken,1899).
2. *albofasciata* Thomson (second generation), (Perez).
3. (stylopized) *convexiuscula* Kirby, England (male, female); *Stylops thwaitei* Saunders (Thwaites, 1841; Smith, 1875; Alfken, 1899).
4. (stylopized) *convexiuscula* Kirby, Mecklenburg, Sachsen, and Elsass, Germany; Switzerland; Hungary (Friese, 1893).
5. *fuscata* Kirby, England (female), (Smith, 1859).

albicrus Kirby.

1. Strandmellen Nordsjaelland, Denmark (male); (*Stylops mellitæ* Meinert), (Meinert 1896 *b*).
2. Hungary (Friese, 1893).
3. (*barbilabris* Kirby), England (male, female); *Stylops dalii* Curtis (Curtis, 1832).

albofasciata Thomson = *afzeliella albofasciata* Thomson.

albopunctata Rossi (*funebris* Panzer), (Perez, 1886).

angustitarsata Viereck = *subtilis* Smith (stylopized) *angustitarsata* Viereck.

aprilina Smith = *nigroænea* (stylopized) *aprilina* Smith.

atriceps Kirby = *tibialis* Kirby.

austriaca Panzer.

1. Fiume, Hungary (Friese, 1893).
2. (*rosæ* Panzer), Epirus (female), (S. S. Saunders, 1872; Perez, 1886).

barbilabris Kirby = *albicrus* Kirby.

biareolina Perez = *Biareolina neglecta* Dufour.

bicolor Fabricius = *gwynana bicolor* Fabricius (vernal).

bimaculata Kirby.

1. (*conjuncta* Smith), (Smith; Perez, 1886.)
2. *decorata* Smith, Bozen, Germany (Friese, 1906).

3. *decorata* Smith (*magrettiana* Schmiedeknecht), Lugens, Switzerland (Friese, 1893).

bipunctata Cresson (*Opandrena*).

1. Sioux County, Nebraska, May (L. Bruner), (female); *Stylops bipunctatæ* Pierce (collection University of Nebraska).
2. Milwaukee, Wisconsin, April 8, 17, (females); *Stylops bipunctatæ* Pierce (collection S. Graenicher).
3. Park County, Wisconsin (C. F. Baker), (female); Indiana (C. F. Baker), (female); Alabama (C. F. Baker), (female); *Stylops bipunctatæ* Pierce.

braunsiana Friese, Hungary (Friese, 1893), Peste (Nassonow, 1893 *a*).

bucephala Stephens.

1. (Perez, 1886.)
2. Hungary (Friese, 1893).

carbonaria Fabricius.

1. Egypt (female), (S. S. Saunders, 1872).
2. Ribben, Kreis Sensburg, East Prussia, May 30 (Dr. P. Speiser in letter).
3. (*pilipes* Rossi), *Stylops nassonowi* Pierce (*melittæ* Nassonow), (Nassonow, 1893 *a*; Perez, 1886).
4. (*pilipes* Rossi), Schwerin and Zerbst, Germany (Friese, 1893).

chalybea Perez = *suerinensis* Friese.

chrysosceles Kirby (Smith; Perez, 1886; Schmiedeknecht, 1884; Chitty, 1902).

cineraria Linnæus (Sagemehl, 1882).

cingulata Fabricius (Perez, 1886).

clarkella Kirby (Smith; Perez, 1886).

claytoniæ Robertson (*Trachandrena*).

1. Thomasville, Georgia, March 21 (M. Hebard), (female), *Stylops claytoniæ* Pierce.
2. Carlinville, Illinois (Robertson, 1891).

collinsonana Kirby = *proxima* Kirby.

combinata Christ, Fiume, Hungary; Straussburg, Germany (Friese, 1893; Perez, 1886).

commoda Smith (*corni* Robertson), Milwaukee, Wisconsin, June 2, 17 (female); *Stylops cornii* Pierce (collection S. Graenicher).

congerens (Schmiedeknecht) Nassonow = *congruens* Schmiedeknecht.

congruens Schmiedeknecht (*congerens* Nassonow), Fiume, Hungary (Friese, 1893; Nassonow, 1893 *a*).

conjuncta Smith = *bimaculata* Kirby.

convexiuscula Kirby = *afzeliella* (stylopized) *convexiuscula* Kirby.

corni Robertson = *commoda* Smith.

crawfordi Viereck (*Pterandrena*), Dallas, Texas, April 26–May 24 (Crawford, Pierce, Bishopp), (puparia, exuvia, females) *Stylops crawfordi* Pierce (collection U. S. Cotton Boll Weevil Investigation).

cressoni Robertson (*Opandrena*), Waldoboro, Maine, June 16 (H. L. Viereck), (female); *Stylops cressoni* Pierce.

curvungula Thomson (*squamigera* Schenck), (Perez, 1886).

decipiens Schenck (Perez, 1886).

decorata Smith = *bimaculata* Kirby *decorata* Smith.

denticulata Kirby (*listerella* Kirby), Osnabruck, Germany (Friese, 1893; Perez, 1886).

desponsa Smith, Nova Scotia (male, female); *Stylops childreni* Gray (Smith, 1853).

dilecta Mocsary = *ephippium* Spinola.

distinguenda Schenck, Agram, Hungary (Friese, 1893; Perez, 1896).

dubitata Schenck, Thuringen; Hungary (Friese, 1893; Perez, 1886).

ephippium Spinola (*dilecta* Mocsary), Hungary (Friese, 1893).

erigeniæ Robertson (*Ptilandrena*), Carlinville, Illinois (Robertson, 1891).

extricata Smith (Perez, 1886).

ferox Smith (Chitty, 1902).

fimbriata Brullé = *variabilis* Smith.

flavipes Panzer (*fulvicrus* Kirby).

1. England (female), (Pickering, 1835; Perez, 1886).
2. Sarepta, Russia (Friese, 1893).

flavoclypesta miserabilis Cresson; Ardmore, Oklahoma, March 12, 1907 (F. C. Bishopp), (female); *Stylops oklahoma* Pierce (collection U. S. Cotton Boll Weevil Investigation).

flessæ Panzer, Fiume, Hungary; *Stylops dominiquei* Pierce (Friese, 1893; Perez, 1886; Dominique, 1891).

florea Fabricius (Perez, 1886).

fucata Smith, Mecklenburg, Germany (Friese, 1893); Varnamyunda ?, March 28–May 5 (Nassonow, 1893 *a*).

fulva Schrank.

1. England (female), (Perkins, 1892; Perez, 1886).
2. Fiume, Hungary; Berne, Switzerland (Friese, 1893).

fulvescens Smith = *humilis* Imhof.

fulvicrus Kirby = *flavipes* Panzer.

funebris Panzer = *albopunctata* Rossi.

fuscata Kirby = *afzeliella fuscata* Kirby.

fuscipes Kirby (*pubescens* Fabricius), England (female), (Pickering, 1835; Perez, 1886).

gallica Perez (Perez, 1886).

gascheti Perez (Perez, 1886).

gwynana Kirby.

1. (*æstival*) England (female), (Pickering, 1835; Smith, 1859).
2. (*æstival*), Mecklenburg and Strassburg, Germany (Friese, 1893).
3. *bicolor* Fabricius (vernal), England (female), (Smith, 1859; Perez 1886).

hartfordensis Cockerell, Thomasville, Georgia, March 27 (M. Hebard), (female); *Stylops hartfordensis* Pierce.

helvola Linnæus = *varians helvola* Linnæus.

hippotes Robertson (*Trachandrena*), Columbus, Ohio, April 21 (female); *Stylops hippotes* Pierce.

humilis Imhof (*fulvescens* Smith), Strassburg, Germany (Friese, 1893; Perez, 1886).

illinoiensis Robertson.

1. Lincoln, Nebraska, April (females); Sioux County, Nebraska, May (female); *Stylops bruneri* Pierce (collection University of Nebraska).
2. Carlinville, Illinois (Robertson, 1891).

imitatrix Cresson (*Trachandrena*).

1. Round Mountain, Texas (female); *Stylops imitatrix* Pierce.
2. Ardmore, Oklahoma, March 12 (F. C. Bishopp), (females); *Stylops imitatrix* Pierce (collection U. S. Cotton Boll Weevil Investigation).

insolita Dufour = *variabilis* Smith.

junonia Viereck = *solidula* (stylopized) *junonia* Viereck.

korleviciana Friese, Fiume, Hungary (Friese, 1893).

labialis Kirby, England (male, female); *Stylops dalii* Curtis (Curtis, 1832; Smith, 1875; Perez, 1886).

labiata Schenck = *schenckii* Morawitz.

lapponica Zetterstedt, England (female), (Theobald, 1892).

latifimbria Perez = *niveata* Friese.

leucolippa Perez (Perez, 1886).

lichtensteinii Schmiedeknecht (Perez, 1886).

listerella Kirby = *denticulata* Kirby.

livens Perez (Perez, 1886).

maggretiana Schmiedeknecht = *bimaculata decorata* Smith.

minutula Kirby = *parvula minutula* Kirby (vernal).

mitis (Perez) Schmiedeknecht, Agram, Hungary (Friese, 1893).

morio Brullé, Hungary (Friese, 1893).

mouffetella Kirby = *tibialis* (stylopized) *mouffetella* Kirby.

multiplicata Cockerell, Milwaukee, Wisconsin, May 30, June 9 (females); *Stylops multiplicatæ* Pierce (collection S. Graenicher).

nana Kirby, England (female), (Perkins, 1892).

nasoni Robertson (metatype), Ashbourne, Pennsylvania, April 19 (H. L. Viereck), (female); *Stylops nasoni* Pierce (from collection H. L. Viereck).

neglecta Dufour (*Biareolina*) = *Biareolina neglecta* Dufour.

nigroaenea Kirby.

1. England (male, female); *Stylops melittæ* Kirby (Kirby, 1802; Perez, 1886).
2. Mecklenburg and Strassburg, Germany; Thüringia; Hungary (Friese, 1893).
3. (stylopized) *aprilina* Smith, England (females, exuvium), (S. S. Saunders, 1872; Smith).

nigrosericea Dours, Hungary (Friese, 1893).

nitida Kirby.

1. England (female), (Smith, 1859; Perez, 1886).
2. Strassburg, Germany; Thüringia; Hungary (Friese, 1893).

nitidiuscula Schenck (Perez, 1886).

nivalis Smith, Milwaukee, Wisconsin, June 11 (female); *Stylops grænicheri* Pierce (collection S. Graenicher).

niveata Friese (*latifimbria* Perez), (Perez, 1886).

nubecula Smith, Twin Mountain, New Hampshire (W. F. Fiske), (exuvium); Colorado (female); *Stylops nubeculæ* Pierce.

nycthemera Imhof, Strassburg, Germany (Friese, 1893, 1906).

ovina Klug (*pratensis* Nylander), Merseburg and Wessenfels, Germany (males, females); *Stylops aterrimus* Friese (Sagemehl, 1882; Friese, 1883, 1893; Nassonow, 1893 *a*).

panurgina Destefani (Perez, 1886).

parviceps Kriechbaumer, Fiume, Hungary (Friese, 1893).

parvula Kirby.

1. England (female), (Pickering, 1835; Smith, 1859; Sagemehl, 1882; Perez, 1886).
2. Gissen (Nassonow, 1893 *a*).
3. *minutula* Kirby, Germany, "everywhere" (Friese, 1893).
4. *minutula* Kirby, England (female), (Perkins, 1892).

piceicornis Dours = *variabilis* Smith.

picicornis Kirby = *trimmerana* (stylopized) *picicornis* Kirby.

picicrus Schenck (*albofasciata* Perez), (Schenck; Perez, 1886).

picipes Kirby = *trimmerana* (stylopized) *picipes* Kirby.

pilipes Rossi = *carbonaria* Linnæus.

placida Smith, Salem, Massachusetts, April 29 (male, female); *Stylops packardi* Pierce (*childreni* Packard), (Packard, 1864, 1872).

polemonii Robertson, Colorado (C. F. Baker) (female); *Stylops polemonii* Pierce.

præcox Scopoli.
1. England (female), (Perkins, 1892).
2. Schwerin, Germany; Hungary (Friese, 1893).

pratensis Nylander = *ovina* Klug.

proxima Kirby.
1. Fiume, Hungary (Friese, 1893).
2. (*collinsonana* Kirby), England (female), (Pickering, 1835)

pubescens Fabricius = *fuscipes* Kirby.

ranunculi Schmiedeknecht (Perez, 1886).

robertsoni Dalla Torre (*Opandrena*).
1. Columbus, Ohio (female).
2. Polk County, Wisconsin (C. F. Baker), (female).

rosae Panzer = *austriaca* Panzer.

rufitarsis Zetterstedt, England (female), (Shuckard, 1866).

rufohispida Dours, "Balearen" and Elche, Spain (Friese, 1893).

rufula Schmiedeknecht, Agram, Hungary (Friese, 1893).

*saliciflori*s Cockerell (*Trachandrena*).
1. Washington State (female); *Stylops saliciflori*s Pierce.
2. var., Seattle, Washington (female).

schencki Morawitz (*labiata* Schenck), Thuringia, Germany; Hungary (Friese, 1893; Perez, 1886).

scita Eversmann, Hungary (Friese, 1893; Perez, 1886).

separata Smith (*labialis separata* Perez), England (female), (Smith, 1847).

sericata Imhof (*vetula* Lepeletier?), Agram, Hungary (Friese, 1893; Perez, 1886).

simillima? Smith, Florida (female, exuvium), (Smith, 1859).

sitiliæ Viereck, Dallas, Texas, May 7 (exuvium), (J. C. Crawford), (collection U. S. Cotton Boll Weevil Investigation).

solidaginis Robertson (*Pterandrena*).
1. Lincoln, Nebraska, August 8, 18, 30; September (L. Bruner, M. H. Swenk, W. D. Pierce), (females); *Stylops swenki* Pierce (Pierce, 1904).
2. Collingdale (Delaware County), Pennsylvania, August 31.

solidula Viereck.
1. Pullman, Washington (C. V. Piper), (female); *Stylops solidulæ* Pierce.
2. (stylopized) *junonia* Viereck, Pullman, Washington (C. V. Piper), (female); *Stylops solidulæ* Pierce.

sparsipilosa Viereck (paratype), Waldoboro, Maine, July 12 (females); *Stylops sparsipilosæ* Pierce.

squamigera Schenck = *curvungula* Thomson.

subcandida Viereck, Southern California (females).

subtilis Smith.

1. Southern California (females); *Stylops californica* Pierce (from collection University of Nebraska).
2. (stylopized) *angustitarsata* Viereck, Washington (female).

suerinensis Friese (*chalybea* Perez), Budapest, Hungary (Friese, 1893; Perez, 1886).

taraxaci Giraud (Perez, 1886).

texana profunda Viereck MS. (*Trachandrena*), Fedor, Texas, March 18 (G. Birkman), (female); *Stylops viereck*i Pierce.

thoracica Fabricius, Epirus (female), (S. S. Saunders, 1872; Perez, 1886).

tibialis Kirby.

1. England (male, female); *Stylops spencii* Pickering (*melittæ* Nassonow), (Pickering, 1835; Nassonow, 1893 *a*).
2. Strassburg, Germany (Friese, 1893; Nassonow, 1893 *a*).
3. (stylopized) *mouffetella* Kirby, England (female), (Pickering, 1835).
4. (*atriceps* Kirby), England (female), (Smith, 1875; Enock, 1875; Perkins, 1892).

trimmerana Kirby.

1. England (male); *Stylops aterrima* Newport (Newport, 1847; Perez, 1886).
2. (stylopized) *picicornis* Kirby, England (female), (Pickering, 1835).
3. (stylopized) *picipes* Kirby, England (female, exuvium), (S. S. Saunders, 1872).

truncatilabris Morawitz, Budapest, Hungary (Friese, 1893).

variabilis Smith.

1. (*fimbriata* Brullé), Epirus (female), (S. S. Saunders, 1872; Perez, 1886).
2. (*piceicornis* Dours (stylopized) *insolita* Dufour), (Perez, 1886).

varians Rossi.

1. England (female), (Pickering, 1835; Smith, 1859; Perez, 1886).
2. Rostock and Strassburg, Germany; Hungary (Friese, 1893); Strassburg (Nassonow, 1893 *a*).
3. *helvola* Linnæus, Rostock and Strassburg, Germany (Friese, 1893).

ventricosa Dours.

1. (Female), *Stylops ventricosæ* Pierce (*melittæ* Nassonow), (Nassonow, 1893 *a*).
2. Fiume, Hungary (Friese, 1893).

vetula Lepeletier=*sericata* Imhof.

vicina Smith.
  1. Salem, Massachusetts, June 18 (female); *Stylops vicinæ* Pierce (*Stylops childreni* Packard) (Packard, 1864).
  2. Canada, New Hampshire (females) *Stylops vicinæ* Pierce.

victima (?) Smith, Nova Scotia (male); *Stylops childreni* Gray (Latreille, 1845; Smith, 1853).

wilkella Kirby=*xanthura* Kirby.

xanthura Kirby.
  1. England (female), (Pickering, 1835; Smith, 1859; Perez, 1886).
  2. Kamionken, Kreis Sensburg, East Prussia, June 14 (female), (Dr. P. Speiser in letter).
  3. Bremen, Germany, April 25 (male, female), (Alfken, 1899).
  4. (*wilkella* Kirby), England (female), (Perkins, 1892; Chitty, 1902).

species, Canada (female), (C. F. Baker).

species, Nevada (female).

species, Southern California (female).

species (*Trachandrena*), Nevada (females).

species, Colorado (female), (collection U. S. National Museum).

Family PANURGIDÆ.

Panurginus Nylander.

ornatipes Cresson (*boylei* Cockerell), Las Vegas, New Mexico, August 3 (W. Porter), (female); *Crawfordia cockerelli* Pierce (collection U. S. National Museum).

new species, West Point, Nebraska, August 10 (male, female); *Crawfordia pulvinipes* Pierce (Pierce, 1904).

Halictoides Nylander.

species, Innsbruck, Germany (female), (Friese, 1906).

Biareolina Dufour.

neglecta Dufour (*Andrena biareolina* Perez), (Perez, 1886).

Family ANTHOPHORIDÆ.

Meliturga Latrielle.

species, Hungary (female), (Friese, 1893, 1906).

GLOSSARY OF TERMS INCLUDED IN THIS WORK.

A.

Ædeagus.—See *Œdeagus.*

Anal lobes.—A pair of reflexed lobes at the apex of the ninth or last ventral segment of the male.

Analogue.—Used in this paper only with reference to parts of the puparium.

Antennal analogue.—See *Analogue.*

Antennal flabellations.—The lobes of the third and succeeding joints of the male antennæ.

Anus.—The pore at the tip of the tenth abdominal segment.

Appendiculate tarsi.—Tarsi in which there seems to be a pulvilliform appendage to each joint.

Autophagus.—Applied to self-feeding larvæ.

B.

Balancers.—Another term for the elytra, or pseudelytra.

Brood canal.—A passage formed between the encased female and its persistent pupal skin, on the ventral side, leading from the genital apertures to the slit between the head and prothorax, on the cephalothorax; it serves as the exit canal for the newly hatched triungulinids.

Buccal cavity.—The mouth opening.

C.

Campodeoid larva.—The triungulinid, or free living hexapod; so called because of its general habitus; this is the first larval stage of the hypermetamorphic insects of the meloid type.

Carabidoid larva.—The second larva of hypermetamorphic insects of the meloid type; so called because of the resemblance to carabid larvæ in that the legs are still available for use.

Cephalic ganglion.—The supracœsophageal ganglion, or brain.

Cephalotheca.—The head cap of the puparium.

Cephalothorax.—The exposed flattened disk of the adult female; it is composed of the adnate parts of the head and thorax.

Chilophagous.—Applied to larvæ which feed upon stored up or foraged provisions.

Coarctate larva.—Generally the fifth instar of hypermetamorphic insects of the meloid type; this stage is semiquiescent, and is in Meloidæ also known as the pseudopupa.

Colony.—A comprehensive term to indicate all forms of social intercourse found amongst insects; for definitions of specific kinds of colonies see *Community, Hill, Hive, Nest.*

Community.—A colony of insects living in close contiguity to each other, but in separate holes, and those of the same species entirely independent of each other; all, however, being dependent upon certain local conditions; the colony may contain numerous solitary dwellers, social colonies, and parasites (Pierce, 1904, p. 181).

E.

Ectoparasite.—A parasite which lives only on the exterior of its host.

Elytra.—See *Pseudelytra.*

Encased female.—The adult female, which is always encased within its pupal skin.

Endoparasite.—A parasite which lives at some time during its biology in the interior of its host.

Epicranium.—The dorsal part of the head bearing the eyes, ventrally fused with the genæ with which it limits the buccal cavity.

Epimeron.—Used by Audouin for *Scutum.*

Exuvium.—The pupal skin after the exit of the male.

F.

Female.—See *Encased female.*

Femoralia.—Pleural segments on each side of the male postscutellum.

Flabellate.—Referring to the antennæ with lateral prolongations of the joints.

Foreign host.—The host of another parasite and not of the species in question.

Free larva.—The *Triungulinid* or *Campodeoid larva.*

G.

Genæ.—The plates at the sides of the eyes beneath, under which the mandibles and maxillæ arise.

Genital apertures.—The unpaired median ventral openings from the female body cavity into the brood canal.

Genital pore.—In the male, the pore at or near the tip of the œdeagus through which the penis may be exserted.

H.

Heterophagous.—Applied to larvæ which have to be fed by others.

Hexapod.—A term incorrectly used to designate the triungulinid; as it is generally used for all insects, it should be discarded in this sense.

Hill.—A colony of fossorial insects in which division of labor is practiced, as, for instance, ants and termites.

Hive.—A social colony of Hymenoptera constructing the nest of wax.

Host.—That insect which directly or indirectly furthers the life of the parasite. See *Foreign host, Maternal host, Permanent host, Temporary host.*

Host plant.—A plant habituated by a certain species of insect.

Hypermetamorphosis.—A complete metamorphosis in which the larva or pupa assumes very different aspects in different instars.

Hypopygium.—A term used by authors in referring to the ninth abdominal segment of the males.

I.

Instar.—Any successive stage in the metamorphosis, limited by two successive molts.

Interlumbium.—Used by Saunders for *Scutellum.*

L.

Labium.—The labium is absent, although the embryo discloses the corresponding lobe.

Labrum.—The labrum is absent; even in the embryo it is not represented by a lobe.

Larvæ.—See *Campodeoid, Carabidoid, Coarctate, Free, Parasitic, Scarabæidoid, Second, Third, Triungulinid.*

Larviparous reproduction.—The production of living young from the body of the parent.

Lumbi.—The side pieces composing the scutum.

M.

Mandibles.—The ensiform chitinous appendages arising under the genæ.

Mandibular analogue.—See *Analogue.*

Maternal host.—The adult insect sheltering the mature female; used in distinguishing between the host at the time of birth of the triungulinid and the larva which it is about to attack and make its permanent host.

Maxillæ.—The second pair of organs of the mouth.

Maxillary analogue.—See *Analogue.*

Mesostigmatal lobe.—A lobate organ, arising from the mesopleuræ and protecting the mesostigmatal pore.

Metapleura.—A narrow side piece bordering the scutum and behind the wings.

Molt.—The perfect or imperfect casting of the skin, or the complete separation but persistence of an immature skin. See *Female, Persistent larval skins, Persistent pupa, Puparium.* The molt is the act which separates the instars and stages.

N.

Nest.—The habitat of paper making, social Hymenoptera.

Ninth abdominal segment.—That elongate terminal segment of the male abdomen apically bearing the genital armature and basally overhung by the tenth segment. See *Hypopygium, Œdeagus.*

O.

Occiput.—The narrow ventral band at the base of the head and limiting the buccal cavity.

Œdeagus.—The tubelike sheath of the penis, arising at the apex of the ninth or terminal segment of the abdomen. See *Paramera, Penis.*

Oligotropic.—Refers to insects which visit a single species or genus of flowers, or sometimes to those which are confined to a single family of flowers.

Ommatidium.—A single facet of the eye, each being separated by a ciliate wall.

Osmosis surface.—Any surface of the body through which vigorous osmotic ingestion takes place.

Osmotic ingestion.—Obtaining food or nourishment through portions of the body at the expense of the vital organs of the host.

P.

Pædogenesis.—The production of young by immature parents.

Palpus, maxillary.—The second joint of the second pair of organs of the mouth.

Paramera.—The sheaths of the penis, together forming the œdeagus. In Strepsiptera they are fused throughout.

Parapleura.—A narrow side piece to which the wing is attached; it lies below the metapleura.

Parasitic larvæ.—All instars of the larval period after the entrance into the permanent host.

Penis.—A very slender tube contained within the œdeagus and which may be exserted through a pore in the latter.

Permanent host.—The host which harbors the strepsipteran from triungulinid until maturity.

Persistent larval skins.—The unshed larval skins which conceal the male pupa and form the pupa case or puparium.

Persistent pupa.—The stage of female maturity in which the adult remains hidden by its pupal skin until death.

Pharynx.—This organ, as the writer interprets it, is composed not only of the lining of the narrow opening near the front of the buccal cavity, but of the entire lining of the cavity, bounded by epicranium, genæ, and occiput. The lining of the pharynx is soft and evidently sensitive and forms, as it were, a broad surface, elevated crater-like in the middle and there constricted into a narrow tube. The clypeus, if present, is fused, and the labrum and labium are absent.

Philotropic.—Refers to flower-loving insects.

Podal analogue.—See *Analogue.*

Podex.—The term used by Kirby for the tenth abdominal segment.

Polytropic.—Refers to indiscriminate flower-visitors.

Postlumbium.—A narrow transverse band behind the scutellum of the male (=*Scutellum* Audouin).

Postscutellum.—The terminal portion of the metanotum (=*Proscutellum* Saunders).

Præscutum—The anterior segment of the metanotum (=*Scutellum* Saunders).

Prepupa.=A true pupal stage formed immediately within the puparium.

Proscutellum.—Used by Saunders for *Postscutellum.*

Pseudelytra.—The appendages corresponding to the elytra of beetles.

Pseudopupa.—See *Coarctate larva.*

Pulvilliform tarsi.—Tarsi having each joint padded with a bladder-like pulvillus beneath.

Pupa.—The true stage of preparation for maturity; typical only in male Strepsiptera where it is found incased by uncast larval skins. See *Prepupa* and *Second pupa,* the two pupal instars.

Puparium.—The incasement formed by the last unshed larval skins, which contains the male pupal instars. The empty puparium is the *Exuvium.* The head cap is the *Cephalotheca.*

R.

Race.—Conspecific insects of a particular strain, lineage, or progeny—a colony among social insects.

Rhipidopterous.—A term referring to the Strepsiptera.

Rhipipter, rhipipteran, rhipipterous.—Terms referring to the Strepsiptera.

Rudimentary.—Referring to organs newly appearing in a group and as yet undeveloped, or to the imaginal buds, or to organs which have reverted to a more primitive form.

S.

Scapular.—A very small piece in front of the wing.

Scarabæidoid larva.—The third instar of hypermetamorphic insects of the meloid type; considered as the middle stage of the second larva; characterized by the resemblance to scarabæid larvæ.

Scutellum.—1. The second segment of the metanotum, immediately behind the præscutum (=*Scutum* Audouin, *Interlumbium* Saunders). 2. This term was used for *Præscutum* by Saunders, for *Postlumbium* by Audouin, and for *Postscutellum* by Kirby.

Scutum.—The pleural segment at each side of the præscutum (=*Epimeron* Audouin). See *Lumbi.* The term *Scutum* was used by Audouin for *Scutellum.*

Second larva.—The period of parasitism preceding the pseudopupa in hypermetamorphic larvæ of the meloid type; comprises the carabidoid, scarabæidoid, and ultimate stages or the second to fourth instars.

Second pupa.—The second true pupal stage, formed within the prepupa.

Spermophagous.—Refers to seed-eating insects.

Spiracles.—In the female these are the prominent eye-like projections at the back of the cephalothorax. See *Mesostigmatal lobe.*

Strepsipter, strepsipteran, strepsipteral, strepsipterous.—Referring to the Strepsiptera.

Style.—The term used by Kirby for the *Œdeagus;* he supposed that all the winged specimens he had seen were females.

Stylopization.—The parasitism of an insect by a strepsipteran.

Stylops, stylopized, stylopid.—Referring to the Strepsiptera.

Subœsophageal ganglion.—See *Thoracic ganglion.*

Supraœsophageal ganglion.—See *Cephalic ganglion.*

T.

Tæniæform.—Ribbon-like, referring to male antennal flabellations.

Tarsal appendages.—See *Appendiculate tarsi.*

Temporary host.—Any insect which may become the agency of transfer of the triungulinid; the function of the temporary host commences at the flower or other point of transfer and ceases when the triungulinid is passed on to another host (temporary or permanent), or to another flower.

Tenth abdominal segment.—That flap-like segment of the abdomen overhanging the tip of the œdeagus and the cavity of the ninth segment; it is usually much surpassed ventrally by the ninth segment. Apically it bears the anus.

Tessellated.—Applied by Templeton to the hexagonal checker-board appearance of the antennæ.

Tessera.—The hexagonal areas of the antennæ (of Templeton).

Third larva.—The sixth and last larval instar of hypermetamorphic insects of the meloid type; characterized by its activity from the coarctate larva.

Thoracic ganglion.—The nervous mass located in the thorax.

Transfer.—The act or acts involved in transplanting the triungulinid from its maternal host to its permanent host.

Transfer plants.—Plants which are the passive agencies in the transfer of the triungulinids from host to host.

Triungulin.—Hexapod larvæ of the hypermetamorphic beetles, having three clawed tarsi (Meloidæ).

Triungulinid (proposed by Doctor Chobaut instead of "*triunguloid,*" 1906).—Hexapod larvæ of hypermetamorphic insects with or without tarsal claws, having also sucker-like pulvilli tipping the tarsi (Rhipiphoridæ; Strepsiptera).

Triunguloid (proposed by the writer in 1904).—See *Triungulinid.*

Trophapothetic.—Refers to insects which store food for their young.

U.

Ultimate stage of second larva.—The fourth instar of hypermetamorphic insects of the meloid type.

V.

Ventral ganglion.—The nervous mass located in the abdomen.

Ventral slit.—A slit-like opening on the venter of the cephalothorax at the base of the head; the exit of the brood canal.

Vestigial.—Used in contrast to rudimentary; referring to organs which have lost all function, as the vestigial mouthparts of the female.

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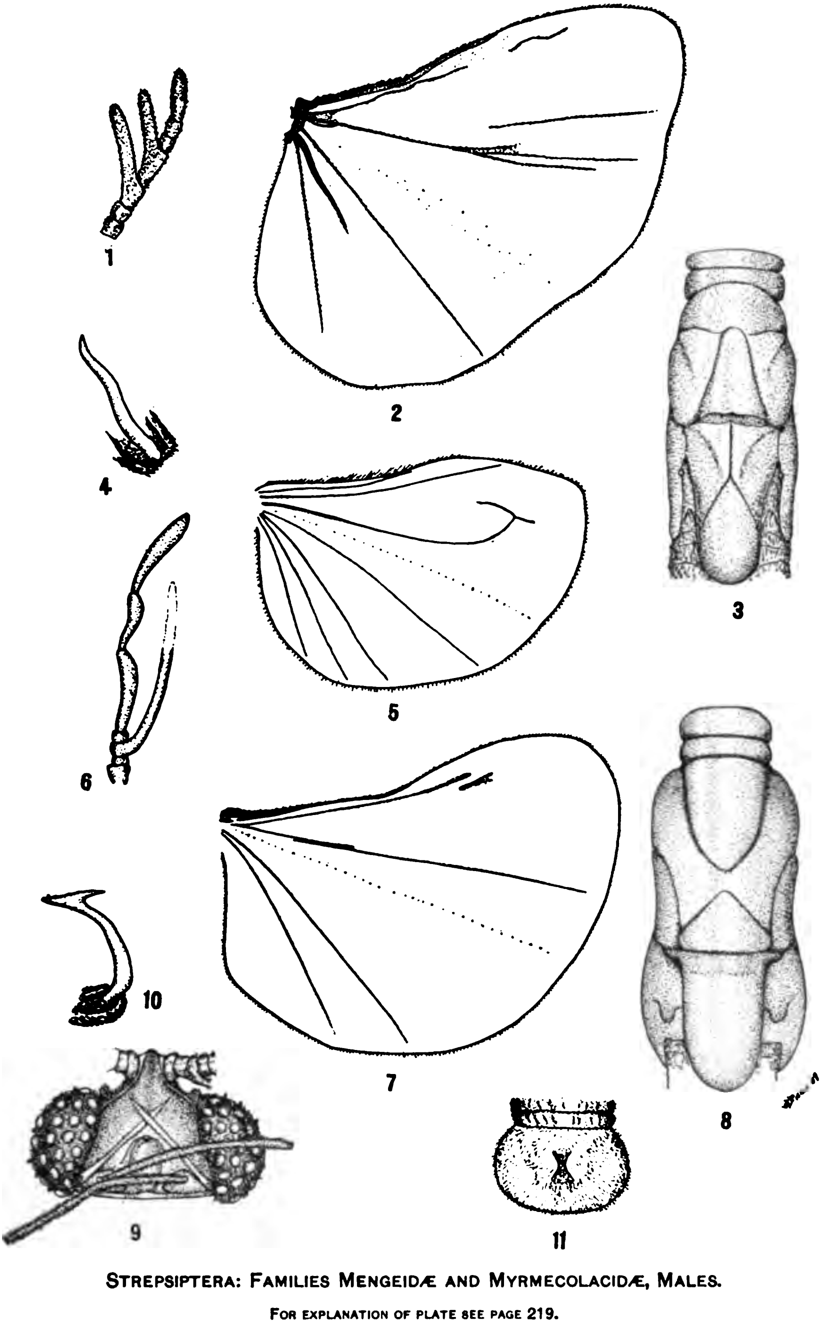
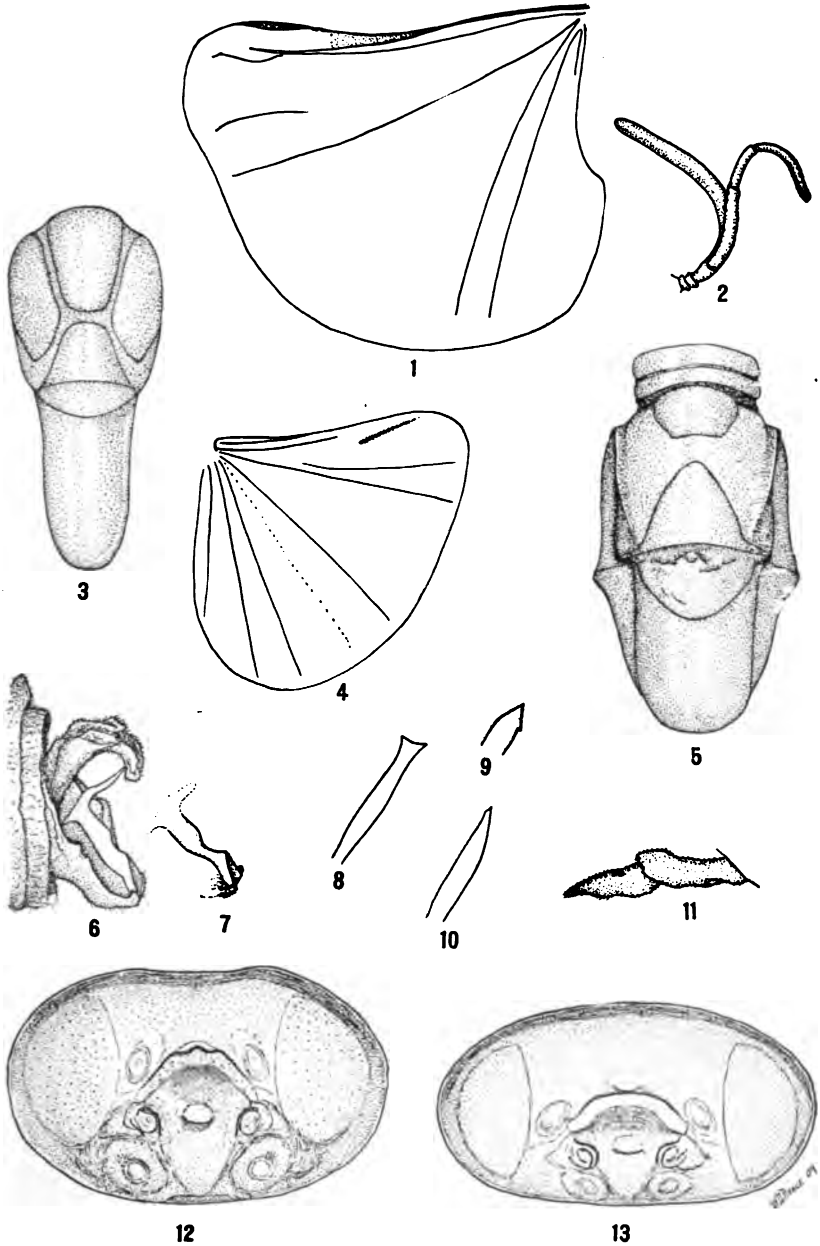


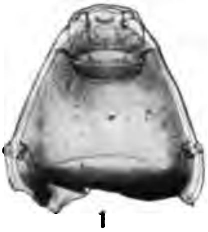
Strepsiptera: Families Mengeidæ and Myrmecolacidæ, Males.

For explanation of plate see page 219.



STREPSIPTERA: FAMILY STYLOPIDÆ, MALES.

FOR EXPLANATION OF PLATE SEE PAGE 219.



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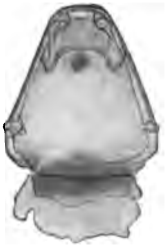

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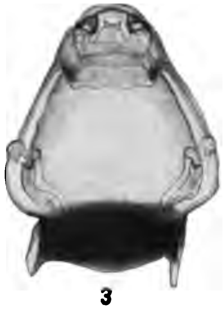

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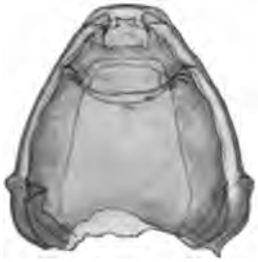

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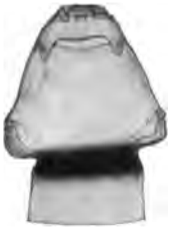

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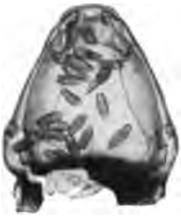

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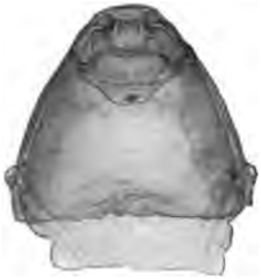

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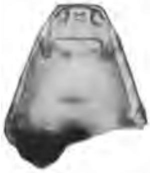

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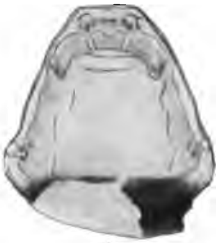

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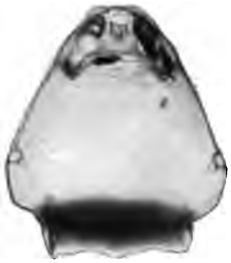

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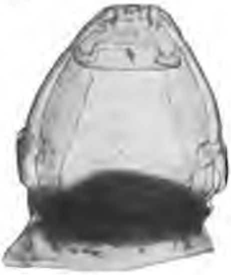

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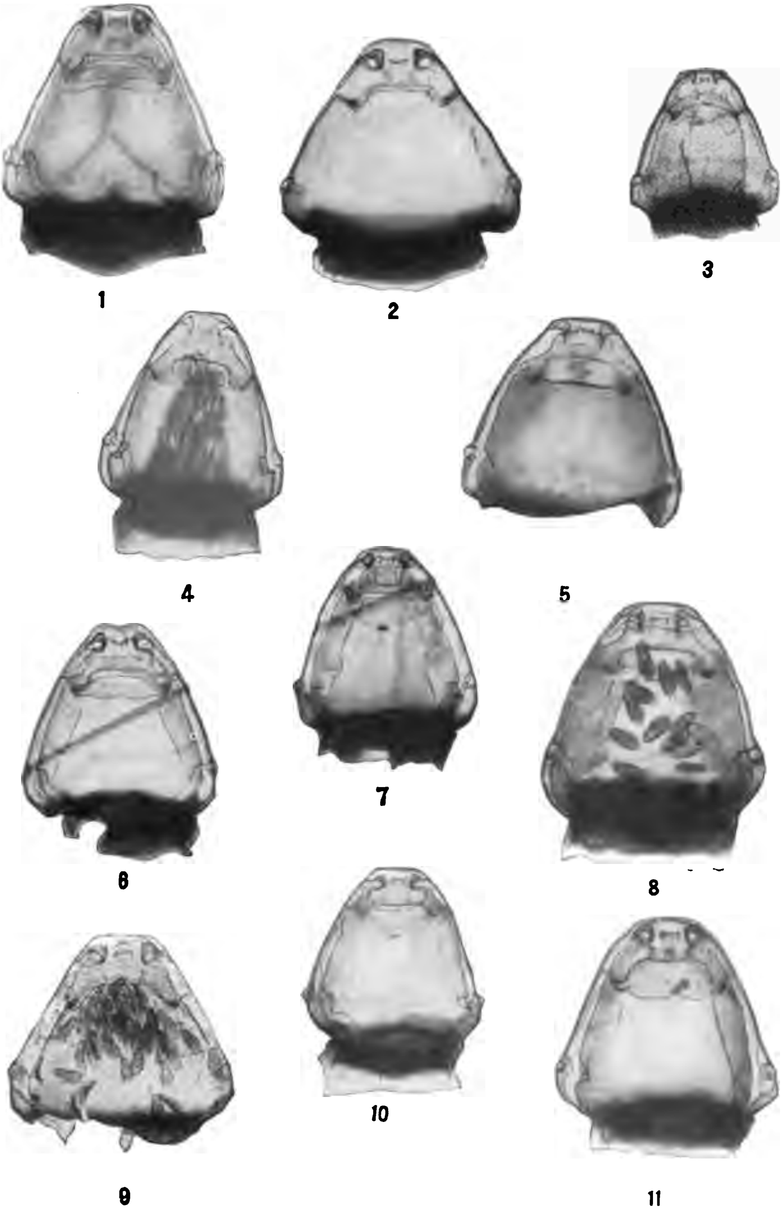
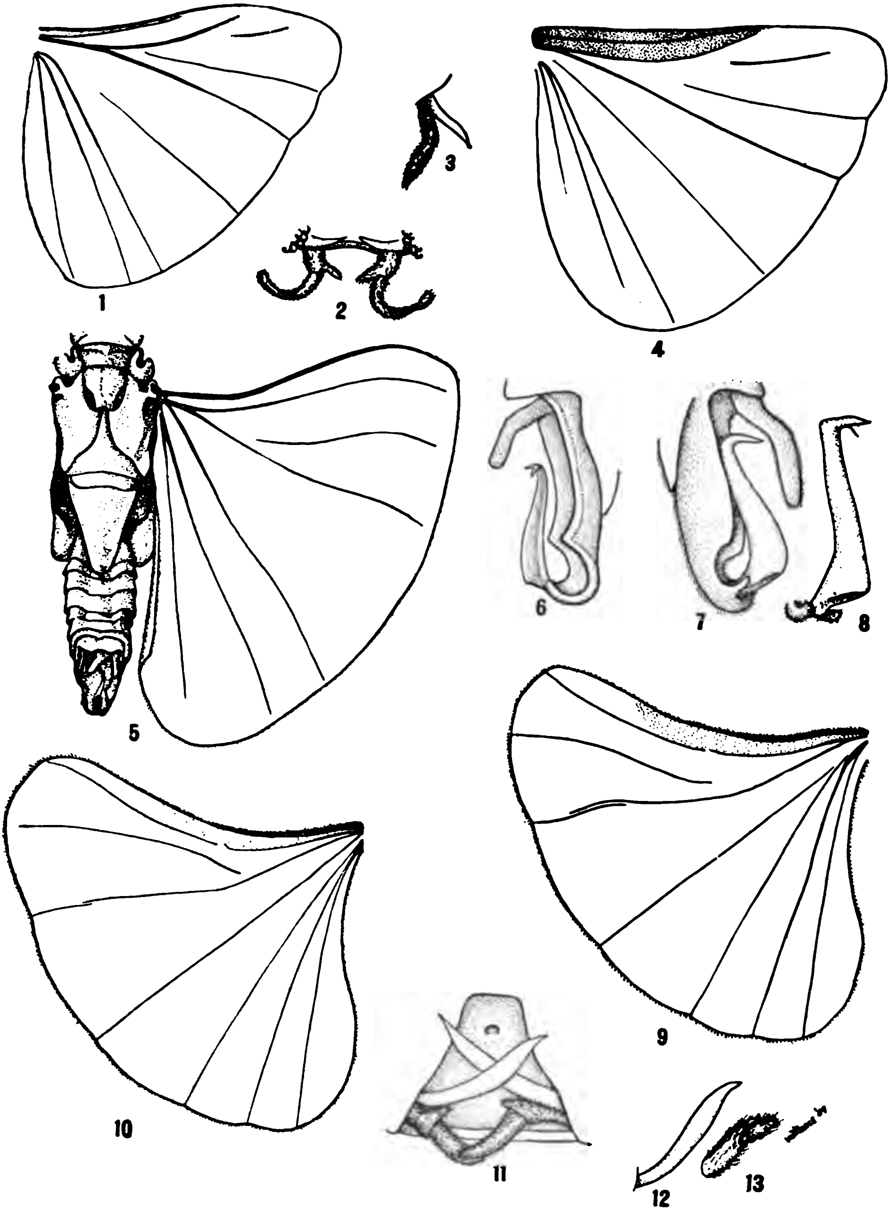
STREPSIPTERA: FAMILY STYLOPIDÆ, FEMALES.

FOR EXPLANATION OF PLATE SEE PAGE 219.



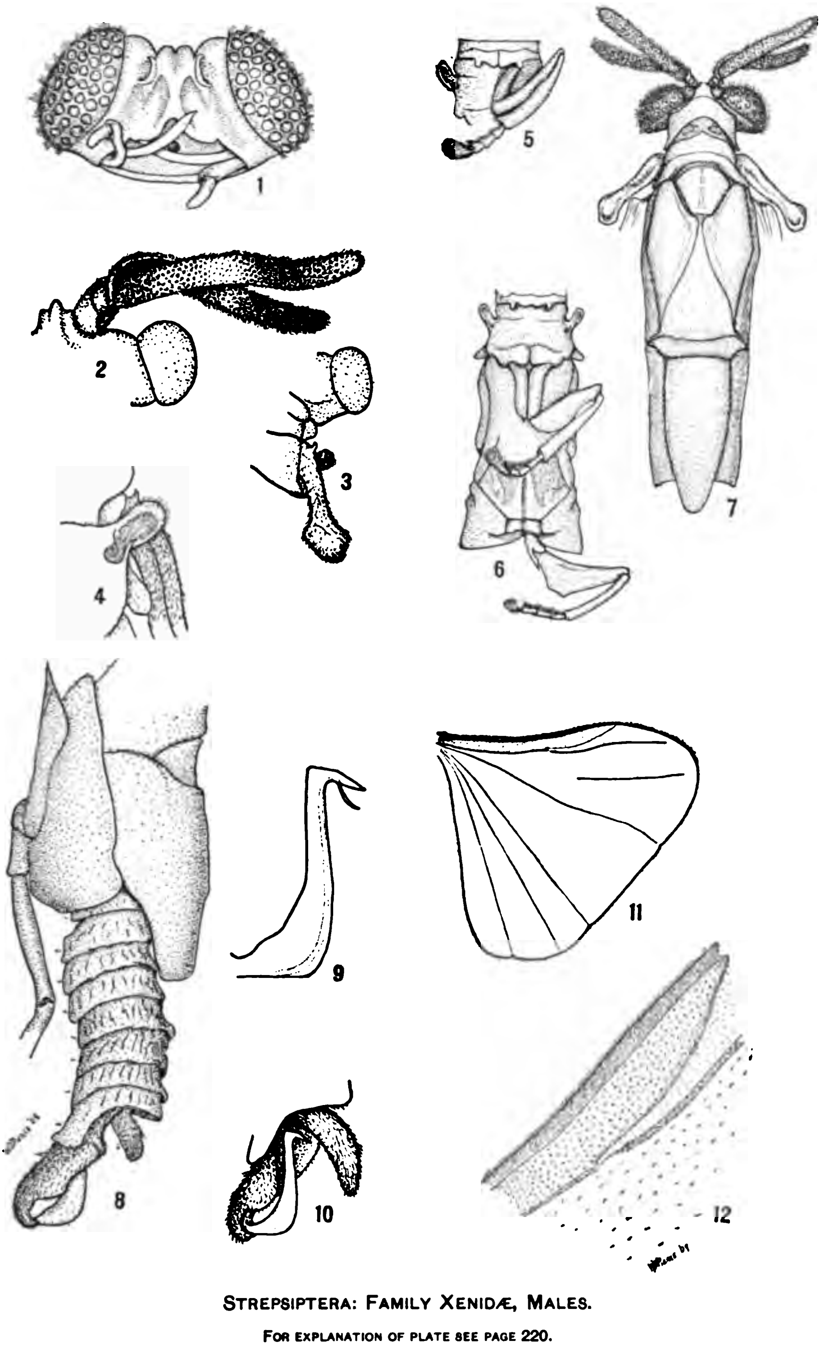
STREPSIPTERA: FAMILY STYLOPIDÆ, FEMALES.

FOR EXPLANATION OF PLATE SEE PAGE 220.



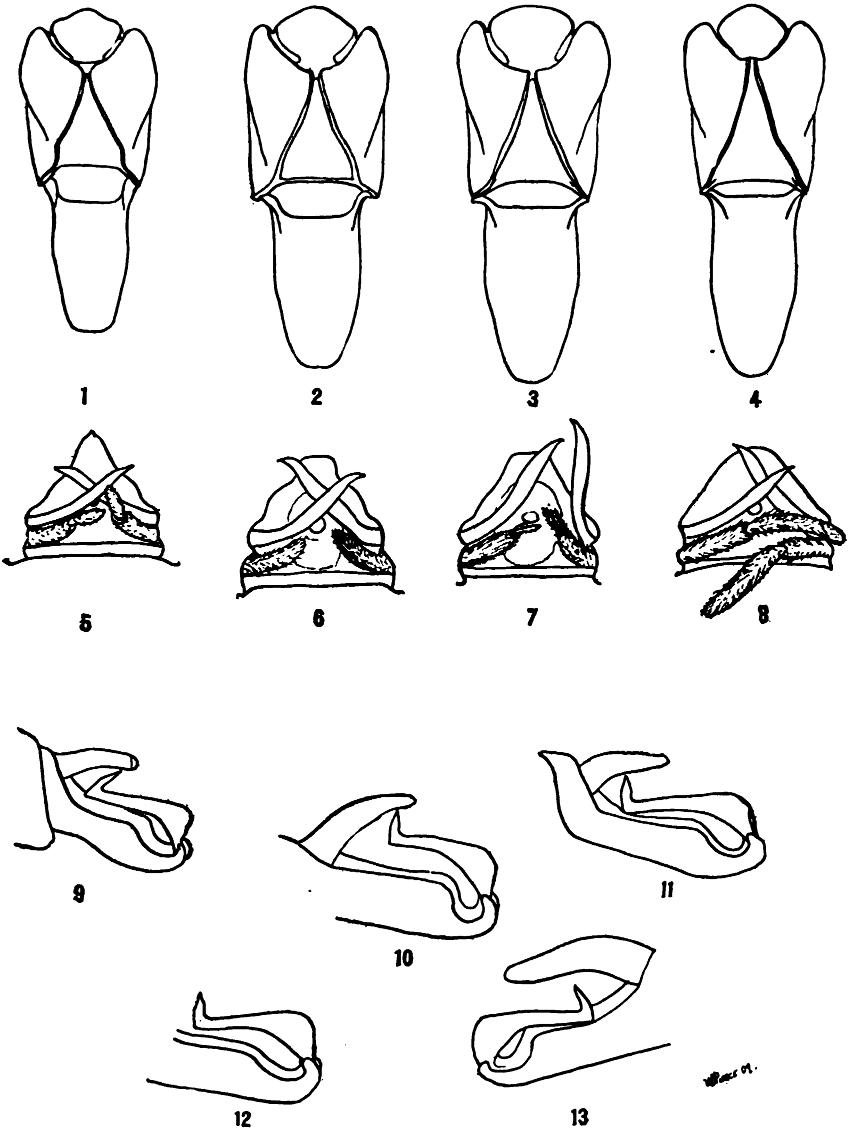
STREPSIPTERA: FAMILIES HYLECHTHRIDÆ AND XENIDÆ, MALES.

FOR EXPLANATION OF PLATE SEE PAGE 220.



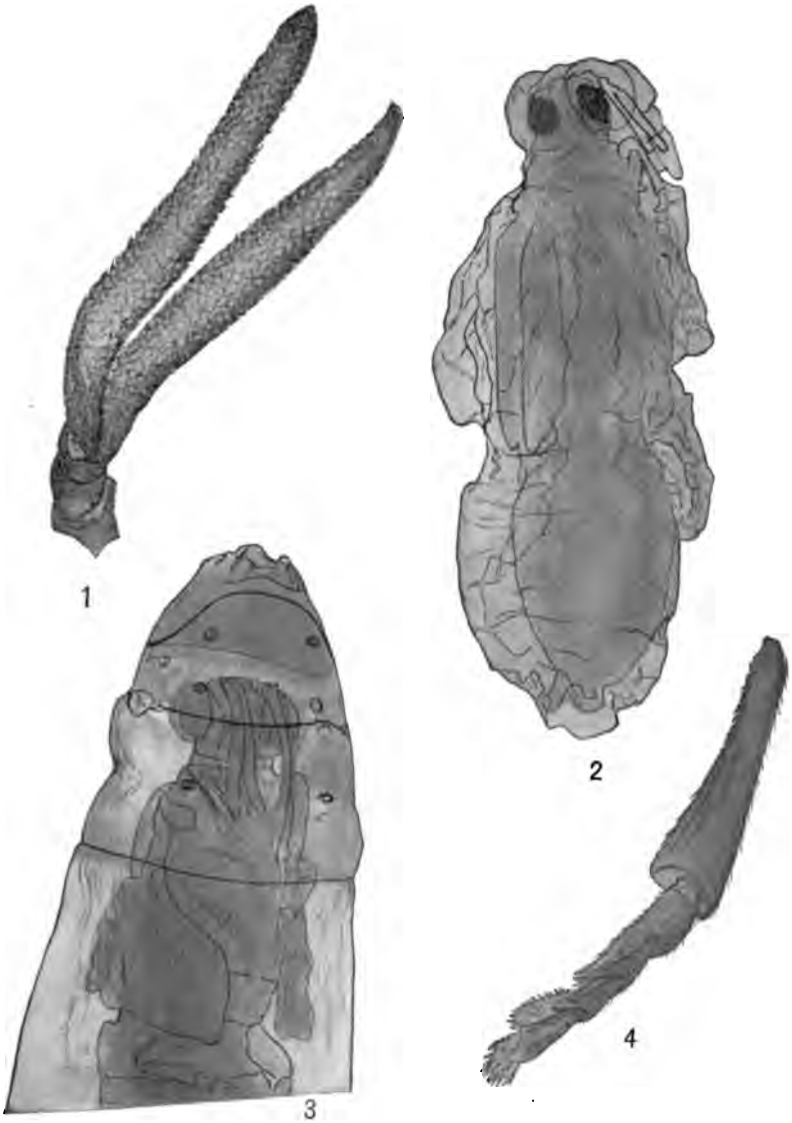
STREPSIPTERA: FAMILY XENIDÆ, MALES.

FOR EXPLANATION OF PLATE SEE PAGE 220.



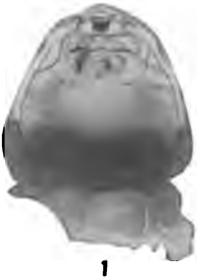
STREPSIPTERA: FAMILY XENIDÆ, MALES.

FOR EXPLANATION OF PLATE SEE PAGE 221.



Strepsiptera: Family Xenidæ, Males.

For explanation of plate see page 221.



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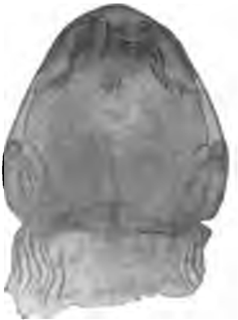

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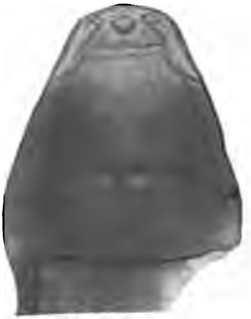

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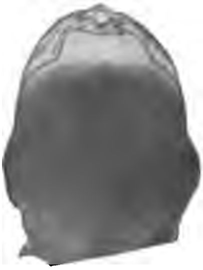

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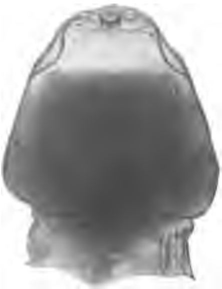

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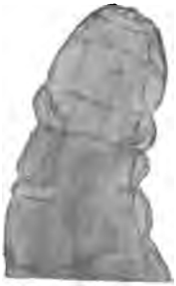

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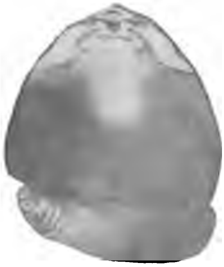

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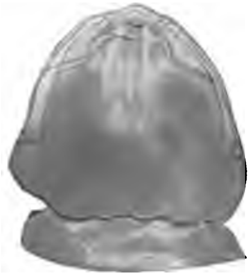

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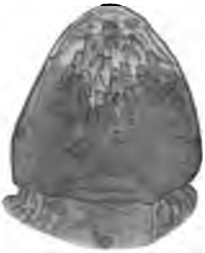

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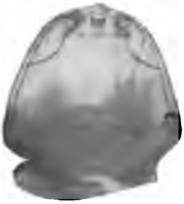

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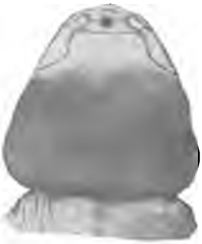

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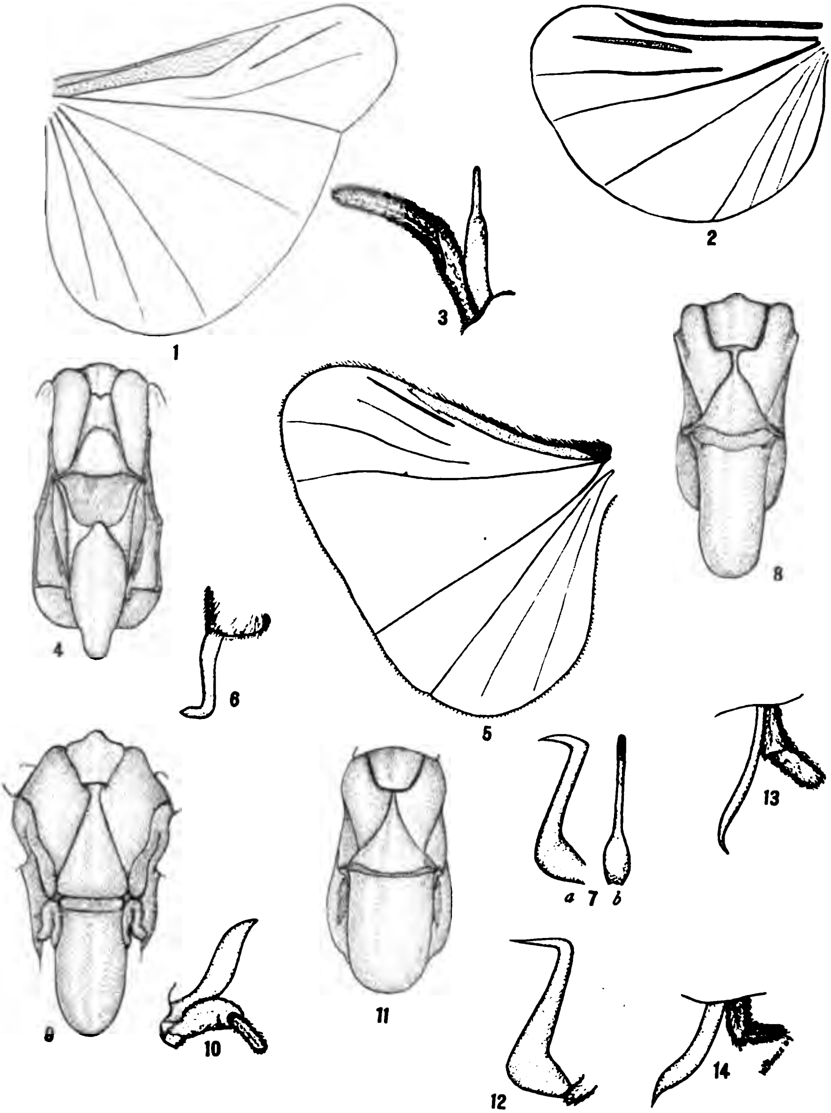
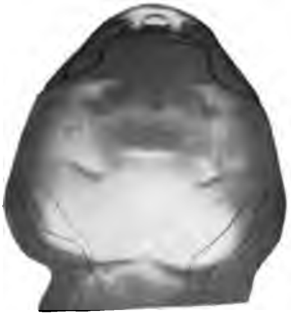
STREPSIPTERA: FAMILY XENIDÆ, FEMALES.

FOR EXPLANATION OF PLATE SEE PAGE 221.



STREPSIPTERA: FAMILY XENIDÆ, MALES.

FOR EXPLANATION OF PLATE SEE PAGES 221, 222.



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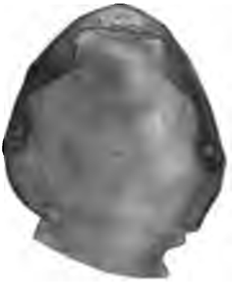

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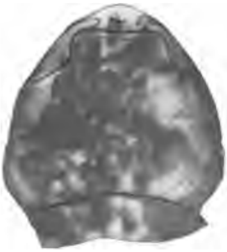

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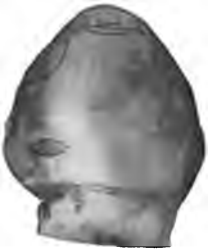

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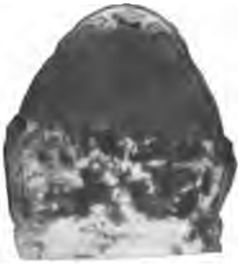

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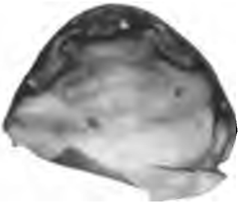

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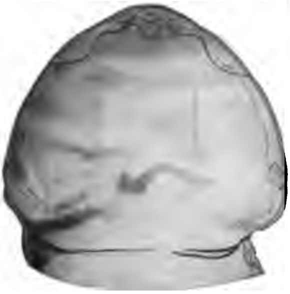

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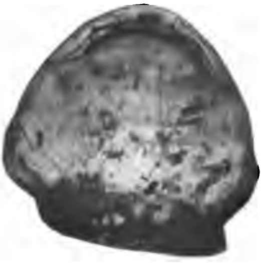

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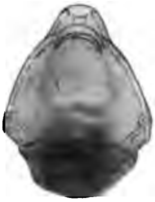
STREPSIPTERA: FAMILY XENIDÆ, FEMALES.

FOR EXPLANATION OF PLATE SEE PAGE 222.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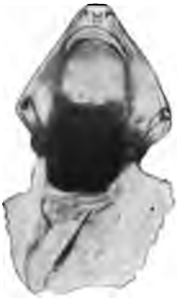
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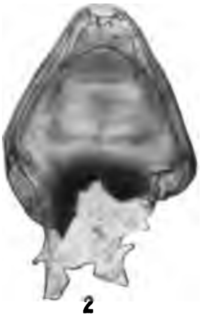
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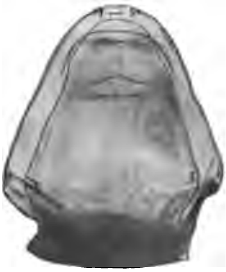
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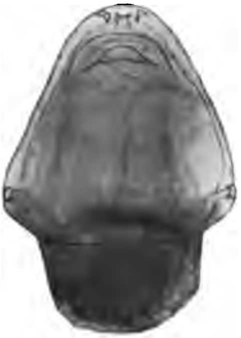
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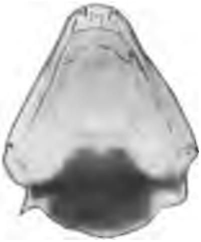
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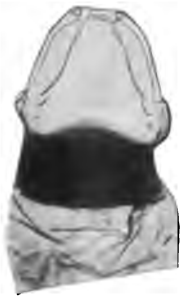
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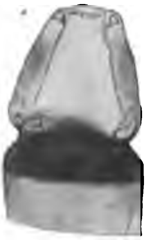
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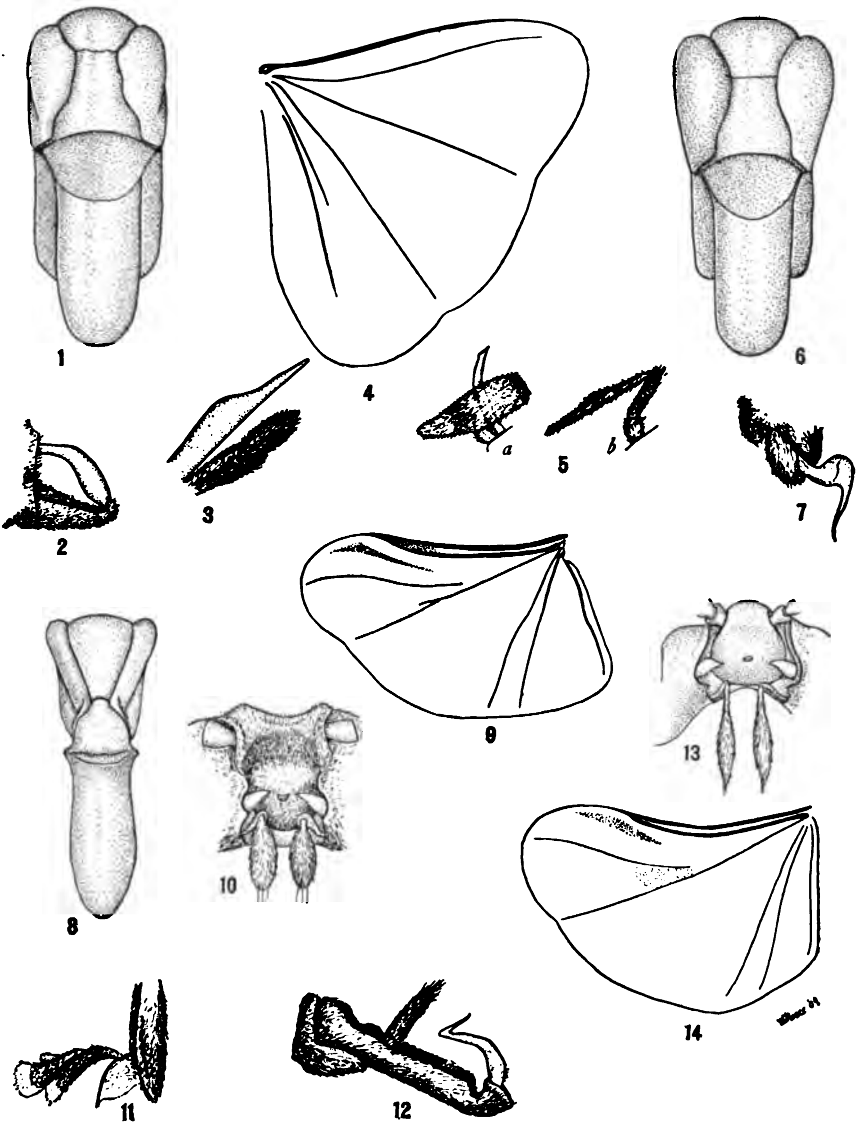
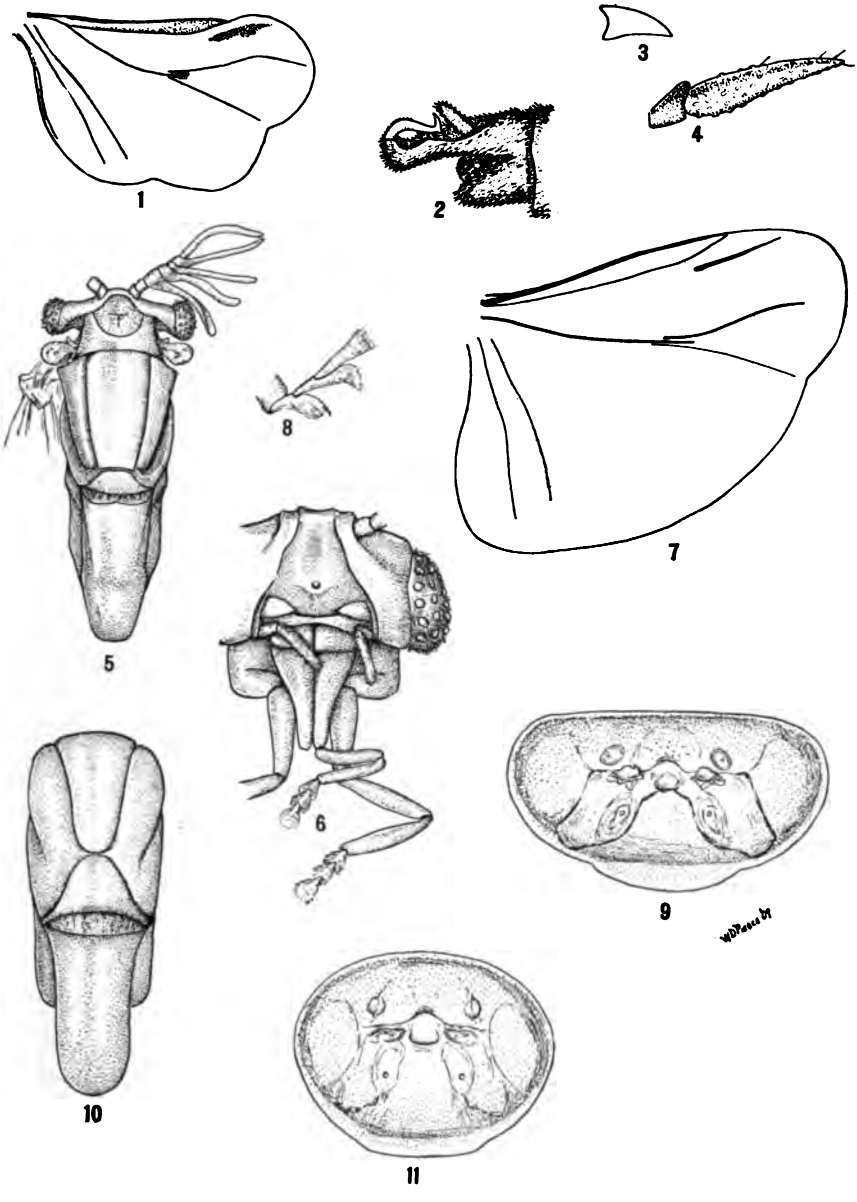
STREPSIPTERA: FAMILY XENIDÆ, FEMALES.

FOR EXPLANATION OF PLATE SEE PAGE 222.



STREPSIPTERA: FAMILIES XENIDÆ AND HALICTOPHAGIDÆ, FEMALES.

FOR EXPLANATION OF PLATE SEE PAGES 222, 223.



STREPSIPTERA: FAMILIES HALICTOPHAGIDÆ AND DIOXOCERIDÆ, FEMALES.

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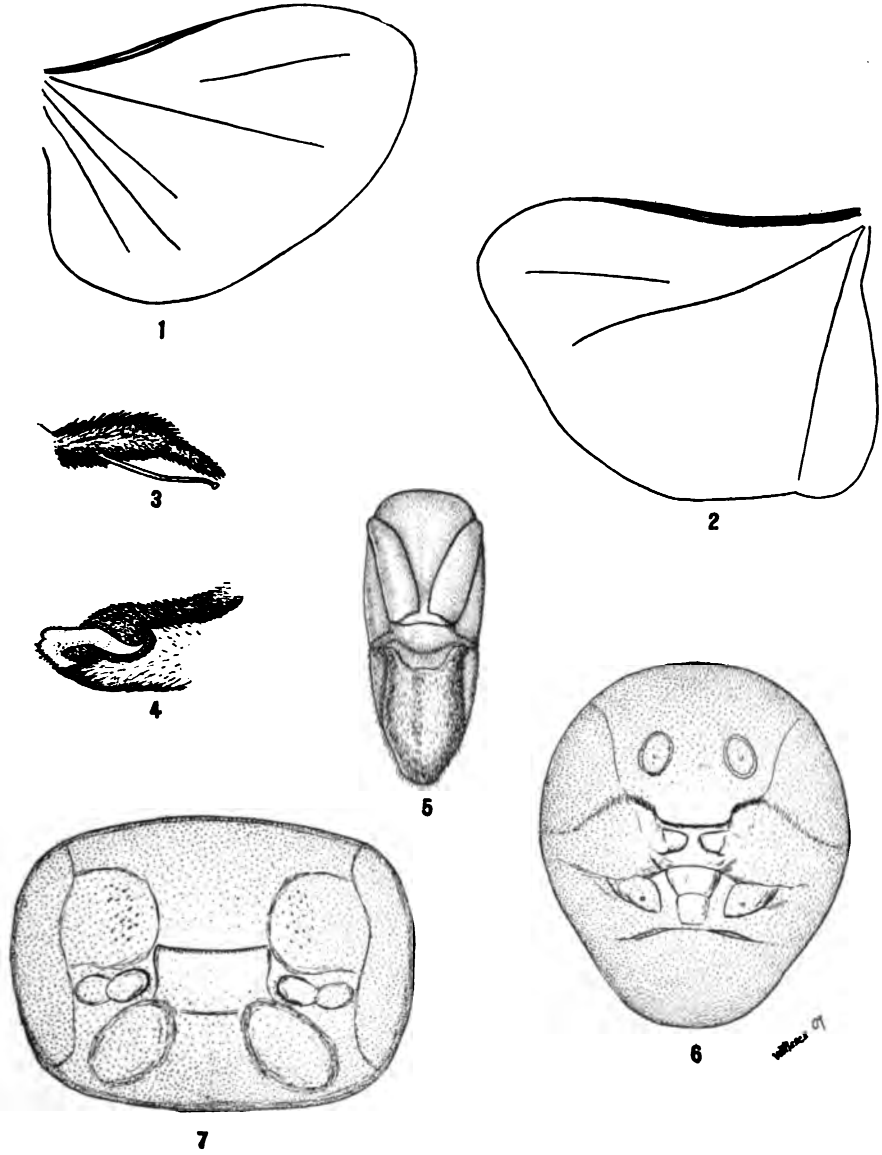

STREPSIPTERA: FAMILY ELENCHIDÆ, MALES.

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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
Bulletin 67

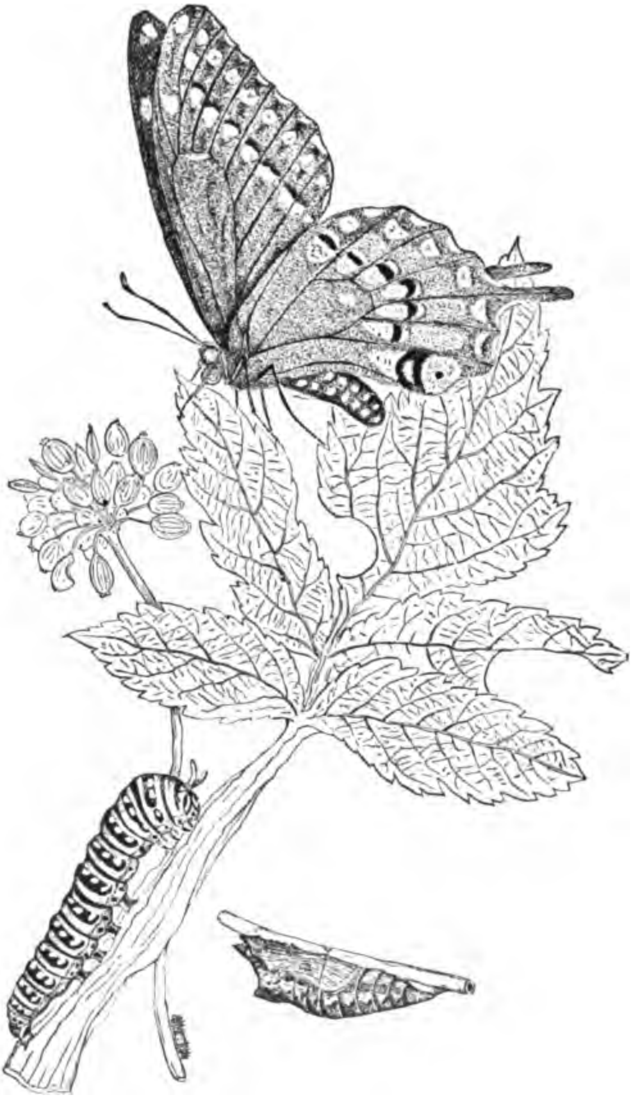
DIRECTIONS FOR COLLECTING AND PRESERVING INSECTS

BY

NATHAN BANKS

In collaboration with various members of the Bureau of Entomology, Department of Agriculture

WASHINGTON
GOVERNMENT PRINTING OFFICE
1909



PAPILIO ASTERIAS—BUTTERFLY, CATERPILLAR, AND CHRYSALIS.

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This work forms No. 67 of the Bulletin series.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as bulletins.

The *Proceedings,* the first volume of which was issued in 1878, are intended as a medium of publication of brief original papers based on the collections of the National Museum, and setting forth newly acquired facts in biology, anthropology, and geology derived therefrom, or containing descriptions of new forms and revisions of limited groups. A volume is issued annually, or oftener, for distribution to libraries and scientific establishments, and in view of the importance of the more prompt dissemination of new facts a limited edition of each paper is printed in pamphlet form in advance.

RICHARD RATHBUN,
Assisant Secretary, Smithsonian Institution,
In Charge of the United States National Museum.

WASHINGTON, U. S. A., *September 16, 1909.*

INTRODUCTION.

The former work, prepared in 1892 under the direction of the late Dr. C. V. Riley, served a most valuable purpose in showing beginners the best methods of collecting and preserving insects. During the years that have passed since its preparation many new methods have been devised and studies conducted on entirely new lines. Therefore it has been considered necessary to prepare an entirely new paper. Many notes on methods of preparation of material have been culled from the pages of the entomological journals, and several members of the Bureau of Entomology have furnished items of value in their special lines.

Practically every entomologist of much experience has developed methods especially suited to his favorite group of insects, and agreeable to his temperament. One can not expect that his methods will be adopted entirely by others. Therefore in the following pages several methods are usually given for doing a thing, and other ways are doubtless familiar to many collectors. As a general rule patience in collecting, care in the handling, and uniformity in the preparation of specimens will result in a good collection. And a good collection is the first requirement and the greatest inducement to study any group.

NATHAN BANKS.

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DIRECTIONS FOR COLLECTING AND PRESERVING INSECTS.

By Nathan Banks,
Custodian of Arachnida, U. S. National Museum.

CHARACTERISTICS OF INSECTS.

Insects are readily distinguished from similar animals by a number of structures or characters. The body is segmented—that is, composed of a series of rings or segments. They have jointed or articulated appendages, such as legs and feelers, or antennæ. Worms do not have these jointed appendages. Insects possess six of these true legs and one pair of antennæ. Spiders do not have antennæ, but have eight legs. Millipedes and centipedes have more than six legs; and crustacea or crabs also have more than six legs and often two pairs of antennæ. Nearly all insects are winged in the adult form. The other groups are not winged. The insects are known scientifically as Insecta, and, together with the crustacea, spiders, centipedes, and millipedes, they form a group known as Arthropoda. Sometimes the insects are called Hexapoda, or hexapod insects, to distinguish them from centipedes and the spiders. Most insects have the body more or less distinctly divided into three or four parts. The head is always distinct (fig. 1), bearing below the mouth-parts and above the antennæ or feelers and a pair of compound eyes. In many cases there are between the compound eyes two or three simple eyes or ocelli. Behind the head is the thorax, but in the case of beetles and some other insects the prothorax is a distinct main division of the body. The thorax is of three parts—prothorax, mesothorax, and metathorax—each part bearing a pair of jointed

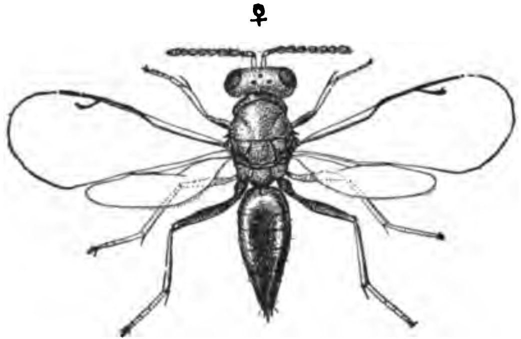

Fig. 1.—Habrocytus thyridopterigis, showing principal parts of an insect.

legs, and the mesothorax and metathorax ordinarily have each a pair of wings. Behind the thorax is the abdomen, bearing at its tip the genitalia, sting, ovipositor, or sometimes jointed setæ or cerci.

Insects are bisexual, there being a male and a female form. In some social insects there are other forms known as workers and soldiers. The female commonly deposits eggs, but in some cases living larvæ. The eggs hatch into larvæ; the larvæ feed, molt, or change their skin several times, and then turn into nymphs or into pupæ. The nymph is active and feeds in a similar manner to the larva, but shows small wing-pads on each side of the thorax, the rudiments of the future wings. From the nymph there issues in time the winged insect. This development through the nymphal stage is called an incomplete metamorphosis. Most insects, however, change from the larva to the pupa, which is quiescent and does not feed, and differs greatly from the larva in appearance (fig. 2). This pupa may be naked, as a chrysalis, or inclosed within a cocoon of silk or earth. From the pupa there issues in due time the winged insect. This line of development is called a complete metamorphosis. These differences above noted are not only external. In the case of a complete metamorphosis, the changes that occur inside of the pupa are often revolutionary in the extreme. The entire internal structure, except the nervous system, may be reduced to a mass of liquid, and the organs of the mature insect developed from this liquid.

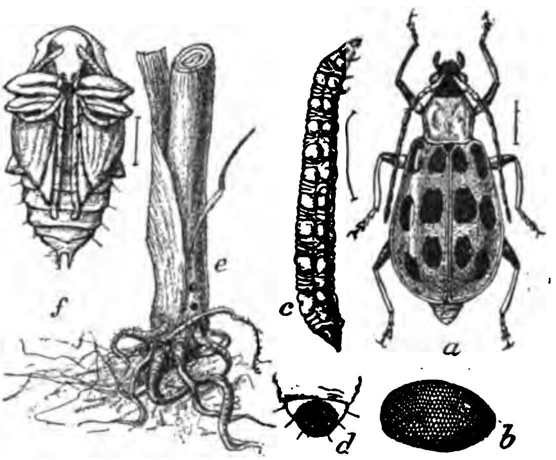

FIG. 2.—DIABROTICA 12-PUNCTATA, SHOWING TRANSFORMATIONS: *a*, BEETLE; *b*, EGG; *c*, LARVA; *d*, END OF LARVA; *e*, WORK OF LARVA; *f*, PUPA.

The wings of the anterior pair in insects are called the forewings or primaries, and the others the hind pair, or secondaries. When the forewings are thickened, they are called tegmina or elytra. The wings have numerous veins through them, the arrangement of which is constant for each species and of great value in classification. This arrangement of these veins is called the venation. The legs are known as front, middle, and hind legs, and each is composed of several parts. The most basal part and attached to the body is the coxa; the next is a minute piece, the trochanter; the third a long piece, the femur; then the tibia; and beyond that the tarsus. The latter is of from one to five joints, and ends in one or two claws. The top of an insect is called the dorsum, and the lower surface the venter; the sides are the pleura. Insects do not breathe through the mouth, but by means of tiny apertures called spiracles placed along the sides of the body, mostly upon the abdomen. Their mouth-parts, or cibaria, present a great diversity of structure and use. Commonly, in biting insects, there is a pair of hard jaws, or mandibles; below them a pair of maxillæ, bearing a pair of maxillary palpi (short, jointed appendages); and an upper and a lower lip. The latter also bears a pair of palpi, the labial palpi. In many forms there is an unpaired central piece, the tongue or hypostome. In many insects these parts or some of them are modified to form a sucking apparatus. The sight of insects is very different from our own, and most insects apparently do not notice objects a few feet away from them. The sense of smell is very acute, and serves to attract them to their food, to the food plant of the larvæ, or to their mates. It is usually considered that the antennæ bear the organs of smell. Many insects make sounds; therefore they must hear. The organs which effect audition are, however, known only in a few groups and are very different from our ears. Most insects do not live long in the adult or winged stage; some only a few days, comparatively few more than one year. Some, however, spend several years in the larval and nymphal conditions. When once an insect acquires wings it does not increase in size, so that the little flies are not, as is often supposed, the young of the big ones.

IMPORTANCE OF ENTOMOLOGY.

When the early entomologists wrote upon their favorite theme it was customary to apologize for studying such unimportant things as insects, and to justify their actions by quotations from the Bible, or reflections on the insignificance of human life. These remarks of the ancient writers are as pertinent as ever, but, thanks to the more enlightened spirit of this scientific age, are no longer necessary. The losses caused by insects to the crops of the country are beyond the appreciation of man's mind. The cost of the damage by a single species often runs up into millions of dollars. Likewise the importance of the beneficial species which prey on and destroy the injurious forms is now, through such striking examples as the Vedalia ladybird, becoming familiar to all. Beside the two notably useful insects—the honey bee and the silkworm—the lac-insects, cochineal, blister flies, ink galls, etc., are of direct benefit to mankind.

The rôle of insects in the transmission of disease has, in recent years, assumed a tremendous economic importance. The cattle tick was for years the principal exponent of the possibilities along this line, but now a dozen or more ticks are known to disseminate diseases. One particular mosquito, *Anopheles maculipennis*, is the main factor in malaria, while another species, *Stegomyia calopus*, is equally as responsible for yellow fever. This small family of insects, entirely neglected a few years ago, is now studied by dozens of entomologists. A flea (*Xenopsylla cheopis*) is now connected with the distribution of the bubonic plague. The house fly, that formerly was thought useful in the destruction of decaying matter, is now known, through its deposition of flyspecks on our food, to be concerned in the spread of typhoid fever, and a possible factor in several other diseases. Undoubtedly other insects will be connected with the spread of disease as the field of medical entomology is daily widened in extent and importance. In the Tropics a large number of diseases are distributed by insects. The Nagana disease of South Africa is distributed by the Tsetse fly; the sleeping sickness by a similar species of fly; the Surra of India by horse flies, etc. Indeed, the wild animals of the forests have lost their terrors, and it is the minute creatures that are full of danger.

In the number of species, insects far exceed all other animals taken together. Estimates made by well-known entomologists of the number of insects in the world have ranged all the way from two to ten millions of kinds. More than 35,000 forms of insects are already known from our country and this is probably not half of the entire number. Recently a famous European entomologist, Dr. A. Handlirsch, has figured out that there are about 385,000 species of insects described from the entire globe. Of them 172,500 are beetles; 60,000 moths and butterflies; 55,000 ants, bees, and wasps; 44,000 two-winged flies, and 33,000 true bugs. One single family of the beetles, the weevils, numbers 23,000 species. And, moreover, fully 6,000 species are described as new by entomologists each year.

Aside from their great numbers or their agricultural or their medical importance, insects are a source of study, of interest, of pleasure and recreation to an ever-increasing number of naturalists year after year. The pleasure in securing the many beautiful forms, the interest in studying the remarkable structures, or the charm in unraveling a peculiar life history has attracted many a busy man as a means of relaxation from the ordinary duties of life. It affords a recreation at once healthful and instructive. The increasing interest in outdoor life and in nature study constantly brings insects into prominence as a group easily observable and replete with interest. All of these factors have combined to give insects such importance that there are now in this country over 2,000 members of the brethren of the net.

CLASSIFICATION.

The arrangement of insects in groups is known as "classification." The plan of classification is as follows: Each kind of an insect is called a species; several kinds that are similar to each other form a genus; several genera that have many structures in common make up a family, and families in turn form an order. Between these groups entomologists sometimes place other groups, such as suborder, below the order; superfamily, above the family; subfamily and tribe, below the family; subgenus, below the genus, and variety, race, subspecies for forms of the species.

Each insect has two names, words of Latin or Greek, at least in form, such as *Papilio asterias*. The first name is that of the genus, the second that of the species; in combination they form the scientific name of the insect. The species name is not used twice in the same genus, and the generic name is used only once in the names of animals. If two or more names have been given to the same insect, we use the first one.

There are many classifications. That of Linnæus consisted of seven orders, but most later writers have insisted on several other orders. Some of these orders are perhaps unnecessary for the purpose of the beginner. About fifteen orders will be sufficient to indicate most of the larger natural groups. These are as follows: Thysanura, Collembola, Platyptera, Archiptera, Orthoptera, Hemiptera, Thysanoptera, Neuroptera, Coleoptera, Strepsiptera, Trichoptera, Lepidoptera, Diptera, Siphonaptera, and Hymenoptera.

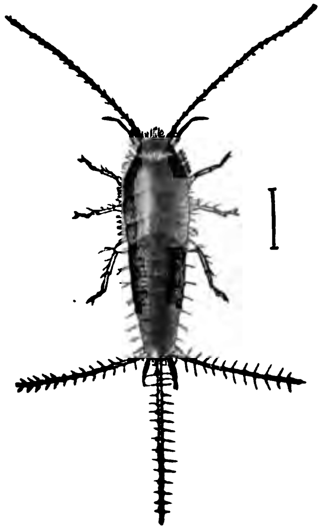
FIG. 3.—ONE OF THE THYSANURA OR FISHMOTHS, LEPISMA SACCHARINA.

THYSANURA.

To this order belong certain wingless insects, the more familiar of which are commonly called fishmoths (fig. 3). The fishmoths occur in houses and infest books and wall paper, feeding on the starchy paste. Other forms occur among fallen leaves in the woods, under stones, etc. They are rather slender, tapering, and with long antennæ, and two or three long setæ or tails. The body is soft and covered with scales. They undergo no metamorphosis, and are the most primitive of the insects, similar to the insects from which have developed all the other orders. They have been studied but little by entomologists.

COLLEMBOLA.

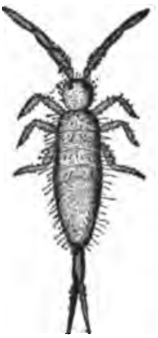

FIG. 4.—A SPRINGTAIL, ENTOMOBRYA LANGUINOSA.

These tiny wingless insects are known to every collector as "springtails," on account of their agility in leaping (fig. 4). Their body is divided into two parts—the head, and a larger posterior part bearing the legs, and beneath near the tip is a forked spring. This spring, or furcula, is held in a catch near the base of the venter, and when let loose sends the insect through the air to a comparatively great distance. Nearly all of them occur in damp situations. As with the Thysanura, they pass through no metamorphosis, and many of them are covered with scales. There are a great many species of these tiny forms, and they have been collected by only a few entomologists. Most of them should be mounted upon slides. Some, however, may be kept in small vials of alcohol, with a little glycerin. Springtails may be collected by the use of a toothpick and a vial of glycerin. Touch the toothpick to the glycerin and then bring it close to the insect, which, upon touching the liquid, will become attached, and then may be washed off in a vial of alcohol. Sometimes a small forceps with a drop of liquid between its nearly closed tips is useful in picking up these agile creatures. Many of them will be found when sifting fallen leaves and moss.

PLATYPTERA.

This order includes small, soft-bodied insects, often wingless. The mouth-parts are formed for biting, although rarely very strong. They are never aquatic in any stage, and the young have a great resemblance to the adults. There are three principal suborders, as follows:

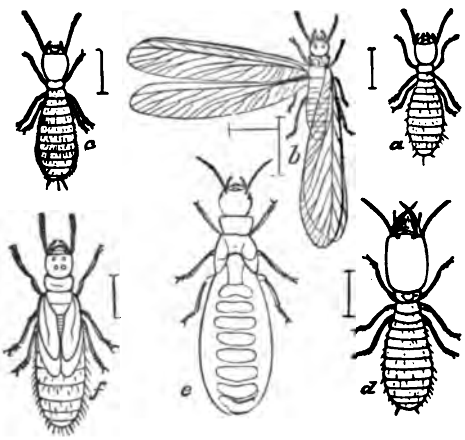

FIG. 5.—A WHITE ANT, TERMES FLAVIPES: *a*, WORKER, *b*, MALE; *c*, *e*, *f*, STAGES OF FEMALE; *d*, SOLDIER.

Isoptera.—To this suborder belong the termites or white ants (Termitidæ) (fig. 5) and a few other allied insects. They are social, living underground in large colonies consisting of several forms of individuals. The queen is the mother of the colony, and after starting a nest she never leaves it. The workers, or neuters, are most numerous and perform all the work. The soldiers are large-headed forms which guard the colony. The males appear at certain times, and they and the queen are winged. The neuters and soldiers are always wingless. Sometimes they do damage to woodwork and to books. A few of the tropical kinds make enormous nests, sometimes higher than a man; others make nests in trees. The Embiids are similar insects, living in less numerous colonies and spinning a web wherever they go. These forms are best collected in alcohol, though some of the winged termites may be mounted on points.

Mallophaga.—These are small, flat, wingless insects (fig. 6) with short legs and a large head, with short antennæ. Since most of these occur on birds, they are commonly called "bird-lice." They have biting mouth-parts, feed upon feathers, hair, and dermal scales, and do not suck blood from the hosts. Several genera live upon mammals. The young are very similar to the adults. Many species are restricted to one host, but in some cases one species occurs on a number of related birds, and many birds harbor two or three different species. They may be preserved in alcohol, but are best studied when mounted upon slides.

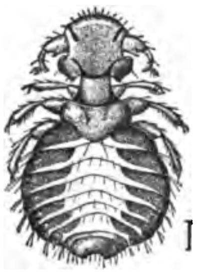

FIG. 6.—ONE OF THE BIRD-LICE, GONIODES FALCICORNIS.

Corrodentia.—The common members of this suborder (family Psocidæ) that occur around houses are known as "book-lice," but many others occur on the bark and leaves of trees and are called "tree-lice." They are all small insects, most of them with four wings, but the species occurring around houses are usually wingless. They are soft-bodied, with long antennæ and slender legs (fig. 7) and feed on minute plant life, on paste, hulls of seeds, etc. Many species are gregarious, at least during their immature stages, and some spin a web over their eggs. They fly at twilight. They should be mounted upon micro-pins, but when possible some should be preserved in alcohol.

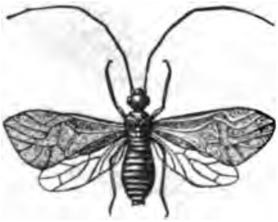

FIG. 7.—A TREE-LOUSE, PSOCUS VENOSUS. (FROM COMSTOCK.)

ARCHIPTERA.

To this order belong the stoneflies, mayflies, and dragonflies, three groups that live for the greater part of the time as larvæ and nymphs in the water. Although there is no real metamorphosis, the younger stages differ from the adult in many ways besides the absence of wings. Together with the Platyptera, Neuroptera, Trichoptera, and Mecaptera, they form the "neuropteroid" insects. There are three suborders, as follows:

Plecoptera.—The stoneflies (family Perlidæ) are soft insects with a rather slender, flattened body and large, many-veined wings (fig. 8). The antennæ are long and many-jointed, and in most cases there are two many-jointed caudal setæ. A part of the hind wings in the larger forms folds up like a fan. The adults take no food. The larvæ and the nymphs are aquatic, often found under stones in streams. The flies should be pinned and the wings spread; when possible, however, it is well to preserve some in alcohol.

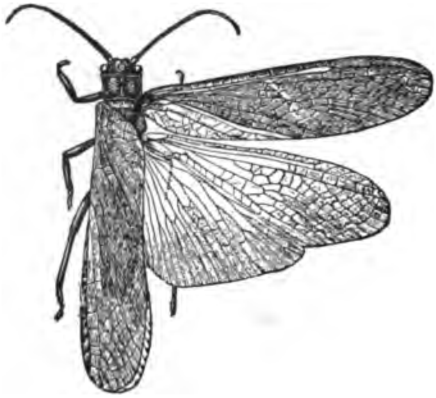

FIG. 8.—A STONEFLY, PTERONARCYS REGALIS. (FROM COMSTOCK.)

Anisoptera.—This suborder includes one family, the Ephemeridæ or mayflies (fig. 163 *b*, *c*), so called, since the adult fly lives but a brief period, longer, however, than one day. They are very fragile creatures, with very short antennæ and long, tapering bodies ending in two or three slender setæ, and have triangular, many-veined wings. The legs are slender and very weak. They have incomplete mouth-parts and take no food. Many species are attracted to electric lights in enormous numbers. A remarkable peculiarity is that after they have issued from the water and have wings, they molt again. This immature winged condition is called the "subimago," and may be distinguished from the adult by the fact that the margins of the wings are minutely ciliate. The larval and nymphal stages are passed in the water, many feeding on vegetation, but some are predaceous. They have leaf-like appendages or gills for breathing. They are a favorite bait with trout fishermen, and are the models for many of the artificial flies. Most should be pinned, but some specimens saved in alcohol.

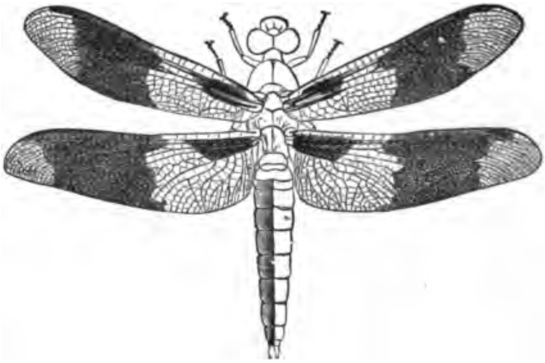

FIG. 9.—A DRAGONFLY, PLATHEMIS LYDIA. (FROM PACKARD.)

Odonata.—The dragonflies (fig. 9), "devil's darning needles," "snake doctors," etc., were familiar to every one of us when a child as objects of dread. However, they are perfectly harmless and may be handled without more than a slight pinch from a few of the larger sorts. They have long, slender bodies; long, many-veined wings; biting mouth-parts, and slender, bristly legs. The smaller kinds, called "damselflies," lay their wings together when at rest. They are predaceous, and catch many mosquitoes and other small Diptera. The larvæ and nymphs are ferocious inhabitants of ponds and rivers, provided with extensile mouth-parts that can suddenly reach forward and catch an unsuspecting insect. The adult should be pinned and a slender hog-bristle pushed through the body from head to near the tail to prevent the loss of head, and keep the abdomen from bending downward. Some keep a few specimens of each kind in alcohol. The colors of some are apt to fade soon after death, so that color-notes should be made before killing the specimens.

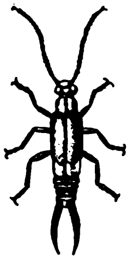

FIG. 10.—AN EARWIG. (FROM PACKARD.)

ORTHOPTERA.

The members of this order have biting mouth-parts, and four stiff, many-veined wings. Those of the front pair, called tegmina, are long and thickened, and usually overlap at base when at rest. Those of the hind pair are large and fold up like a fan, and are hidden by the tegmina. The head is large, and the legs rather stout; often the hind pair is enlarged and fitted for jumping. The younger stages, except for the absence of wings, resemble the adult, and a number of species never acquires wings, or at least only rudimentary ones. Their food habits vary greatly, according to the groups. There are five distinct sections.

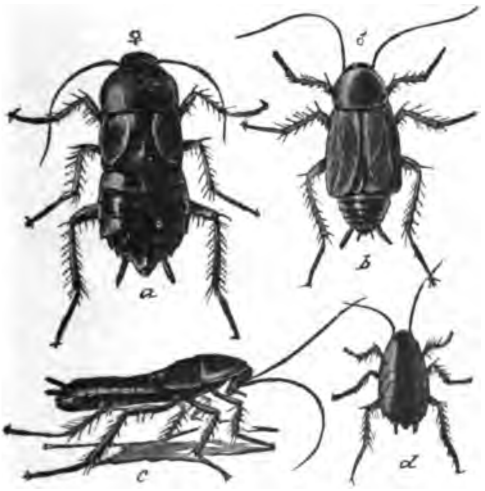

FIG. 11.—ONE OF THE COCKROACHES, BLATTA ORIENTALIS: *a*, FEMALE; *b*, MALE; *c*, SIDE VIEW; *d*, YOUNG.

(1) The Dermaptera (Forficulidæ), or the earwigs (fig. 10), differ from the other forms in having a pair of crude, forceps-like appendages at the tip of the body. The idea that they get into ears is

entirely erroneous, for these tiny insects are quite harmless, and feed on decaying matter. The hind wing of these earwigs is a very peculiar structure, unlike the wings of any other insect.

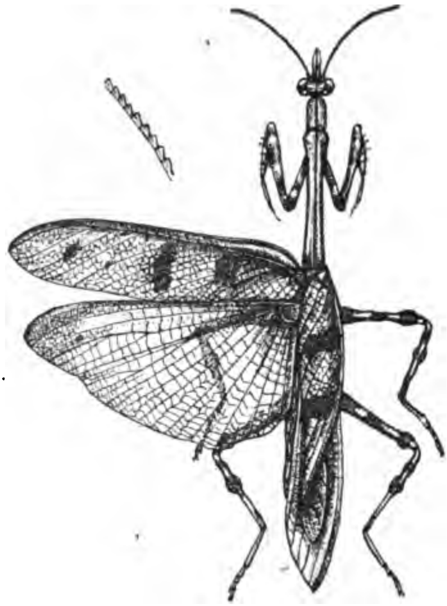

FIG. 12.—A MANTID, VATES TOWNSENDI.

(2) The Cursoria includes the family Blattidæ or cockroaches, too familiar to inhabitants of cities. They have long, threadlike antennæ, and slender, spiny legs, and in many the wings are very short or even absent (fig. 11). The eggs are laid in cases, called "ŏotheca," which the female carries about for some days. They usually feed on decaying vegetable matter.

(3) The Raptoria (family Mantidæ) and (4) the Ambulatoria or walking-sticks (family Phasmidæ) are both most numerous in tropical countries. To the former belong the leaf-insects, and to the latter the stick-insects, both striking examples of protective resemblance. The Mantidæ (fig. 12) lay their eggs in a large mass attached to a tree or fence. They have the first pair of legs enlarged and spiny, with a short claw near tip. They stand motionless for hours with their raptorial front legs extended, a position which has won them the name of praying mantis. Their prayer, however, is for prey. The Phasmidæ (fig. 150) are strict vegetarians.

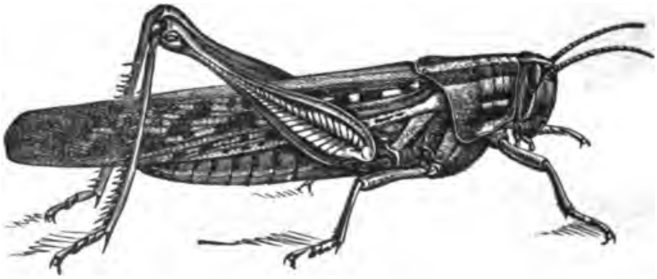

FIG. 13.—A GRASSHOPPER, SCHISTOCERCA AMERICANA.

(5) The Saltatoria includes the grasshoppers, meadow locusts, and crickets. These forms are very common in our country and are recognized by having enlarged hind femora. The grasshoppers (family

Acridiidæ) have short antennæ. The two other groups have extremely long and many-jointed antennæ, and also differ from the grasshoppers in having a prominent ovipositor.

The grasshoppers (figs. 13, 151) (or locusts), as is well known, are often very destructive to crops. They usually deposit their numerous eggs beneath the soil in late summer or autumn, the young hatching in the spring and feeding on the adjacent vegetation. Some species, as the "Rocky Mountain locust," at times become so numerous that they are obliged to migrate to obtain food. These migrating swarms were formerly a tremendous scourge to the western farmers, but now their breeding grounds have been largely destroyed by cultivation. Grasshoppers are more numerous in species in the prairie regions than elsewhere in the country. Several species can make a noise by their wings when in flight.

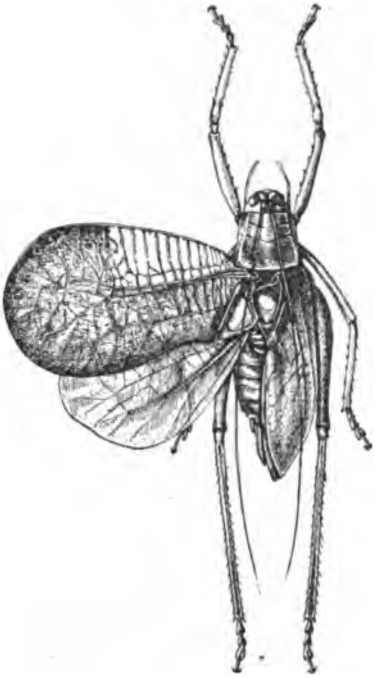

FIG. 14.—THE KATYDID, CYRTOPHYLLUS PERSPICILLATUS.

Quite a number of meadow locusts and katydids (family Locustidæ) are predaceous and feed on plant-lice or other small insects. They are commonly green in color, and occur on shrubs or in grass, where they are not readily noticed. The males of all the species can make sounds by rubbing the base of one

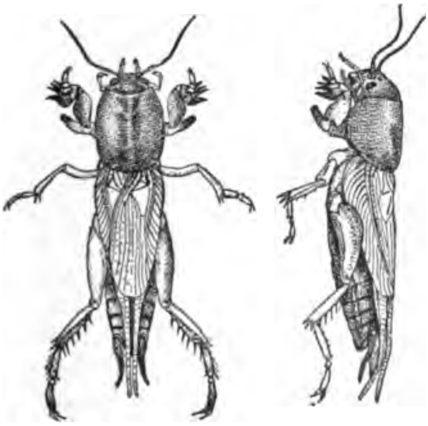

FIG. 15.—A MOLE-CRICKET, SCAPTERISCUS DIDACTYLUS.

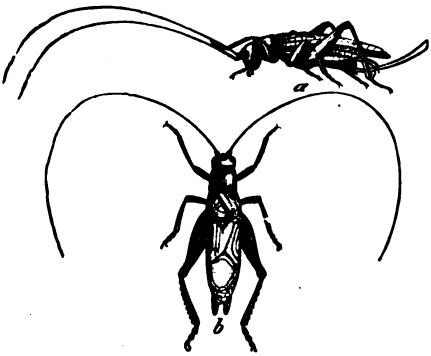

FIG. 16.—A TREE-CRICKET, OROCHARIS SALTATOR: a, FEMALE; b, MALE.

wing over the other. This part of the wing is especially modified to make the sound. Each species has a characteristic note, which can be recognized by one familiar with them. The katydid (fig. 14) lives in the tops of trees, and though the telltale notes are well known to many, the insect is rarely seen by anyone.

The crickets (family Gryllidæ) are very similar to the meadow locusts, but have only three joints to the tarsi, while the locusts have four. The males of both groups have a special singing organ, a modification of the veins at the base of the wings. Some crickets (fig. 15), known as mole crickets (*Gryllotalpa*), are very different from the others, and have their front legs fitted for digging in the soil. They also have short antennæ and lack the ovipositor. Most of the crickets are phytophagous, but those found on trees (fig. 16) are predaceous.

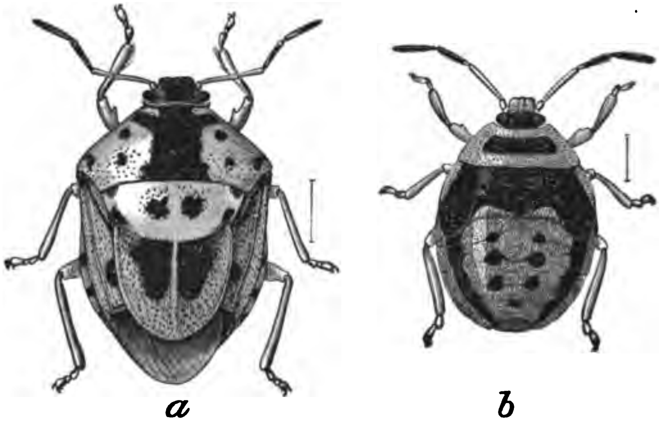

FIG. 17.—A PENTATOMID BUG, STIRETRUS ANCHORAGO: *a*, ADULT; *b*, NYMPH.

In all of these three families there are some short-winged or wingless forms (fig. 152), and sometimes a species varies in wing-length.

HEMIPTERA.

The Hemiptera, or Rhynchota as they are known to many Europeans, differ from the members of all previous orders in the nature of their mouthparts. These are slender and needlelike and form a beak fitted for sucking liquids, as blood, or the sap of plants. It is to these insects that the entomologist applies the name "bug." The transformations are incomplete—that is, the young have much resemblance to the adults, and there is no resting stage. A few families (Coccidæ and Aleyrodidæ) have a more complete metamorphosis. There are four distinct groups, or suborders—the Heteroptera, Homoptera, Phytophthires, and the Anoplura.

The HETEROPTERA have the basal part of the forewings hardened and thicker than the apical part, and the apical parts cross flatly when at rest. The beak arises from the front part of the head. With most of the Heteroptera (see fig. 17) the head is much smaller than the thorax and triangular in shape. Many of the species can cause considerable pain by puncturing the skin with their sharp-pointed beak. They also have the power of emitting when disturbed a nauseous odor, which comes from drops of fluid secreted from two pores on the under side of the thorax. Most of the species feed on plants, but several families are predaceous. Quite a number of Heteroptera live in moist places. The chinch bug and squash bug are well-known members of this group, which includes also the notorious bed-bug (fig. 18) of many aliases. The latter creature is never winged, and also does not occur under the bark of trees in the woods.

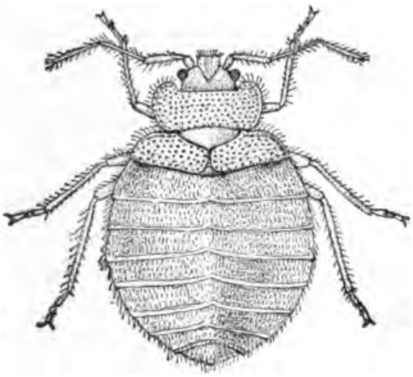
FIG. 18.—THE BED-BUG, CIMEX LECTULARIUS.

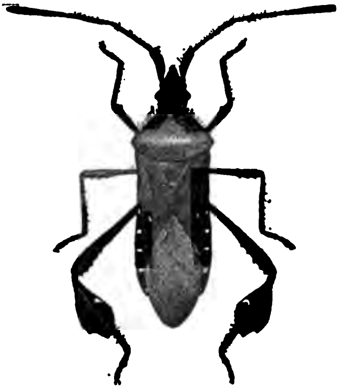
FIG. 19.—A COREID BUG, LEPTOGLOSSUS OPPOSITUS.

Many species deposit their eggs in clusters on the food plant; others insert the eggs in the plant tissue. Most have but one generation a year, passing the winter in the adult condition under loose bark or among fallen leaves.

There are many families, the most prominent of which are the following:

The Pentatomidæ (fig. 17), which have five-jointed antennæ, and the body rather broad, with short head, and legs of moderate length. Most are brown or green in color, but some are prettily marked in bright colors.

The Coreidæ (fig. 19), which have rather longer bodies, four-jointed antennæ, a four-jointed beak, and legs of moderate length; often some of the legs are enlarged, or have membranous expansions.

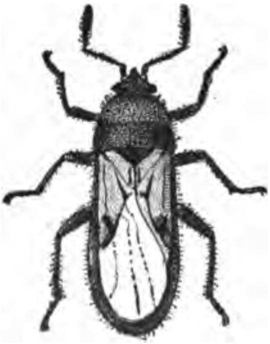
FIG. 20.—THE CHINCH BUG, BLISSUS LEUCOPTERUS, A LYGÆID.

The Lygæidæ (fig. 20), very similar to the Coreidæ, but all are much smaller, and with fewer veins in the membrane of the wing. Many of them live on the ground.

The Reduviidæ (fig. 144), which have four-jointed antennæ, a three-jointed beak, and simple eyes, or ocelli. The body is rather slender. All members of this family are predaceous.

The Capsidæ (fig. 21), with four-jointed antennæ and beak, without ocelli, and with only two cells in the membrane of the wing, are small, delicate, rather slender insects most of which feed on plants.

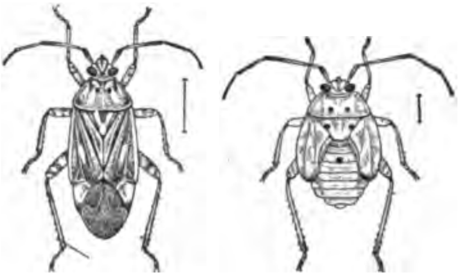

FIG. 21.—ONE OF THE CAPSIDÆ, LYGUS PRATENSIS.

The Tingitidæ, or lace bugs (fig. 22), feed on the under surface of leaves of various trees.

The Cryptocerata, with the antennæ almost invisible, includes a number of aquatic bugs (figs. 145, 146) of very diverse structure and habits. Some are the largest species of the order, such as the *Belostoma* or "electric light bug."

The arrangement of these families is still a subject of much discussion, but is usually in two groups: Hydrocorisa (water bugs) and Aurocorisa (land bugs); Gymnocerata (visible antennæ) and Cryptocerata (hidden antennæ); or Trochalopoda and Pagiopoda, according to the nature of the coxal joint.

The HOMOPTERA differ from the Heteroptera in having the forewings of even texture throughout, and the tips do not lap over one another when at rest. Moreover, the beak in the Homoptera appears to arise from the posterior end of the head beneath, and the antennæ are very short, with a fine terminal bristle. The Homoptera are mostly small insects, and all feed on vegetation. Nearly all of them are expert jumpers, although they do not have any enlarged legs. They are commonly known as leafhoppers (Jassidæ), treehoppers (Membracidæ), froghoppers (Cercopidæ), etc.

The Jassidæ (fig. 23) are small and slender insects, abundant in meadows, and sucking the juices from plants. Many of them are green or brown in color, but some are striped or spotted with red or pale. The Membracidæ (fig. 24) have the prothorax enlarged to cover most of the body. Usually they are elongate triangular from above, and with folded wings and legs drawn up they have little resemblance to an ordinary insect. The Cercopidæ are usually diamond-shaped insects; the young often live in a mass of froth or spittle, which they produce as they suck the juices from the plants.

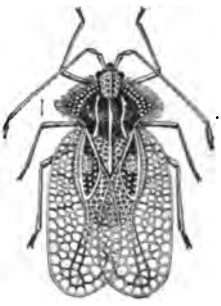

FIG. 22.—A TINGITED BUG, GARGAPHIA ANGULATA.

To this suborder belongs the cicada (fig. 25), or "locust," whose shrill voice is a familiar sound in summer. They are the largest insects of this suborder, and many of the tropical forms are of beautiful coloration. One of these cicadas, the seventeen-year form, spends seventeen years under ground as a young insect, and then issues in great numbers. The tropical lanternfly, of the family Fulgoridæ (see fig. 147), is also a member of this group.

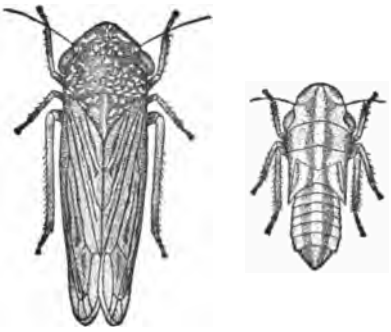

FIG. 23.—ADULT AND YOUNG OF A LEAFHOPPER, OR JASSID, ONCOMETOPIA LATERALIS.

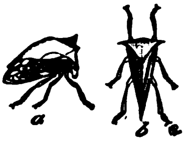

FIG. 24.—A TREE-HOPPER, OR MEMBRACID, CERESA BUBALUS: *a*, SIDE VIEW; *b*, TOP VIEW.

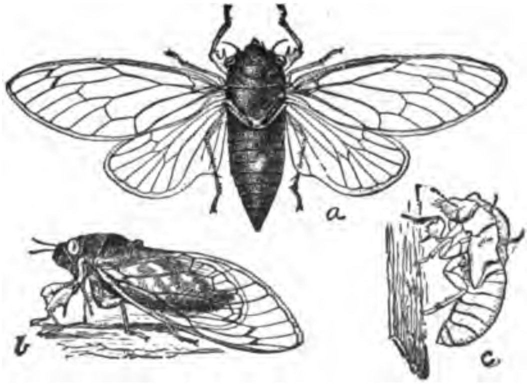

FIG. 25.—THE 17-YEAR LOCUST, TIBICEN SEPTENDECIM: *a*, WITH WINGS SPREAD; *b*, WITH FOLDED WINGS; *c*, NYMPH.

The suborder PHYTOPHTHIRES includes many small insects known as plant-lice or aphids, and scale insects or coccids. Their antennæ are long, without apical bristle, and their wings are filmy. The plant-lice (family Aphidæ) occur in great numbers on many plants and are a familiar nuisance to the growers of flowers and indoor plants. They have a winged and a wingless stage, and they increase largely by a sort of budding process without depositing eggs. Plant-lice (fig. 26) include some of our most destructive insects, as the grape Phylloxera, hop aphis, and apple aphis. Many species live on different plants at different portions of their lives. The Psyllidæ (fig. 148), or jumping plant-lice, are similar to the plant-lice, but rarely occur in such numbers and always increase by the deposition of eggs, as do most other insects. Some of them produce galls. The Coccidæ, or scale insects (fig. 149), includes the notorious San Jose scale, mealy bugs (fig. 27), and other similar forms. In these the male only is winged, and then with but one pair, while the female remains attached to the twig or leaf, a mere protuberance with little resemblance to an ordinary insect. The male, unlike other Hemiptera, passes through a complete metamorphosis. The adult male has no mouth-parts and does not feed, while the female has a long flexible beak with which she sucks up the sap of the plant. Although many species are very destructive, there are several very useful insects, such as the cochineal and lac insects; the former used for a dye, and the latter to make shellac.

The suborder **Anoplura** (Pediculi) includes a few wingless parasites known as lice (fig. 28), which infest various mammals, including man. They are flat, with short legs, the tips of which end in a large claw opposed to a projection from the preceding joint. They should be collected in alcohol; or, for study, mounted upon slides, always with the name of the host.

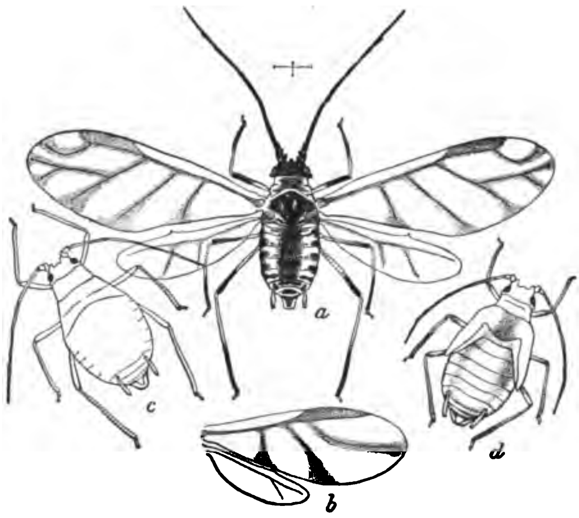

FIG. 26.—A PLANT-LOUSE, RHOPALOSIPHUM VIOLÆ: *a*, ADULT; *b*, WINGS; *c*, LARVA; *d*, NYMPH.

THYSANOPTERA.

This small order is based on tiny insects known as "thrips" (fig. 29). They are slender, rather flat, with pointed head, and short legs which end in two-jointed tarsi without claws. The four wings are very slender, with few veins, and fringed with long hairs. A few species, however, have apterous females. Their mouth-parts are peculiar, and their metamorphosis is incomplete. They feed on vegetation and are quite numerous, and many fly during fine days in the autumn and may be seen on clothing, in houses, etc. Others hibernate under loose bark. All should be mounted upon slides, care being taken to spread out the wings.

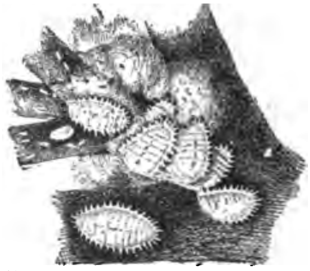

FIG. 27.—A MEALY BUG, DACTYLOPIUS CITRI.

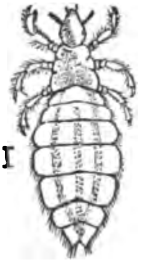

FIG. 28.—THE HEAD LOUSE, PEDICULUS CAPITIS.

NEUROPTERA.

These are biting insects with four large, many-veined wings, and a complete or nearly complete metamorphosis. The legs are of moderate size, and the tarsi have five joints. They are a small order, and as many fly only at night they are not often seen by the general collector of insects. There are three suborders. The Megaloptera include large species like the horned Corydalis or hellgramite fly, whose larva, known as the Dobson, is to be found in most of our running streams. The insects of the suborder Stegoptera are smaller, more delicate insects, which fold their wings roof-like over the body. The ant-lion flies (Myrmeleons) (fig. 30), whose larvæ (fig. 31) make funnel-shaped pits in sand in the bottom of which they wait with extended jaws for any small insects that may tumble into the trap, belong to this group. The gauzy lacewing flies (*Chrysopa*) (fig. 32) or "golden eyes," have a spindle-shaped predaceous larva which wanders over leaves in search of plant-lice. The parent fly of many species deposits the eggs in clusters at the tips of slender wiry stalks. Some of the species have an extremely vile odor. The Mantispidæ (fig. 153) have the front legs enlarged and spiny, with which they catch small insects. The young are parasitic in egg sacs of wandering spiders. The suborder Mecaptera (Panorpidæ) (fig. 154) are flies having the head prolonged below. The body is slender and cylindrical. In the male it terminates in a pair of large claspers, from which these insects obtain the common name of "scorpion-flies." They catch and eat small insects. Their larvæ resemble the true caterpillars, but have eight pairs of abdominal legs. These larvæ live in the soil and are predaceous, but are very rarely found, although the adult flies are common in the Eastern States.

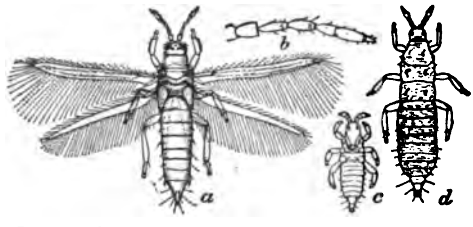

FIG. 29.—ONE OF THE THYSANOPTERA, THRIPS TABACI: *a*, ADULT; *b*, ANTENNA OF SAME; *c*, YOUNG LARVA; *d*, FULL-GROWN LARVA.

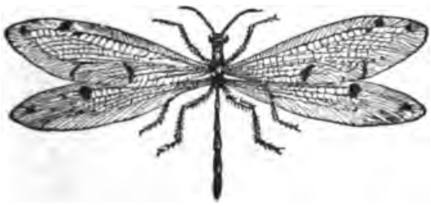

FIG. 30.—AN ANT-LION, OR MYRMELEON. (FROM PACKARD.)

COLEOPTERA.

The Coleoptera, or beetles, as they are universally called, are the insects most common to all observers. Their fore-wings, called elytra (singular, elytron) are hard or leathery, and when at rest meet down a straight line on the back. They show few traces of veins, and beneath them are folded the other wings, which, though of moderate size, are sufficient for good flight. In numbers the beetles outrank all other orders. Some, if not the largest, are the weightiest of insects, and others are so tiny as to be scarcely visible to the unaided eye. The ease with which they may be collected and preserved, together with the bright colors of many species, have made the order a very popular one with collectors.

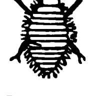

FIG. 31.—A MYRMELEON LARVA.

Beetles pass through a complete metamorphosis. The larvæ show great variety in shape and structure, but are often elongate, rather flat creatures, with or without legs, and with strong biting jaws. The pupa shows the legs and antennæ of the adult folded against the body, and the wing-pads are applied to the sides. Several arrangements of the beetles in large groups or sections have been proposed by coleopterists, yet none of such striking superiority as to command general adoption. In Europe, Professor Kolbe and Doctor Ganglbauer have proposed new systems of Coleoptera, which have many valuable points; however, a slight modification of the arrangement used by Doctors Le Conte and Horn is as useful, and probably as natural, as any other. It divides the beetles into seven sections, as follows:

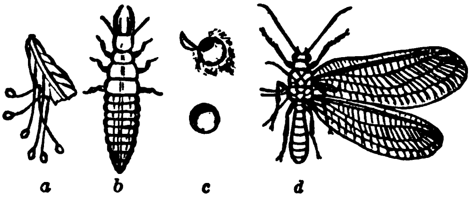

Fig. 32.—A lacewing fly, Chrysopa: *a*, Eggs; *b*, larva; *c*, cocoons; *d*, fly with left wings removed.

Adephaga.—The antennæ are simple, not with leaflike plates nor enlarged at tip; all the tarsi five-jointed. The mouth-parts are usually well developed, and the abdomen shows six segments on the under side. The larvæ are usually very active and commonly predaceous. They have a tapering body, widest near the middle, with prominent head and jaws, prominent legs, ending in two claws, and frequently one, two, or three terminal processes or tails to the body. Many of the species are aquatic (Dytiscidæ, fig. 128). Others are called ground-beetles (figs. 33, 127) and tiger-beetles. The tiger-beetles (fig. 129) (Cicindelidæ) are usually of very brilliant coloration, but most of the beetles (Carabidæ) of this section are black or at least without particular markings.

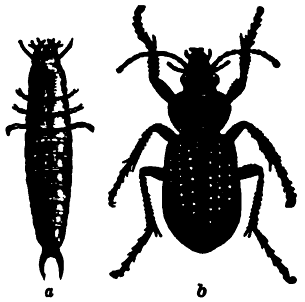

Fig. 33.—A ground-beetle, Calosoma calidum: *a*, Larva; *b*, adult.

Clavicornia includes those beetles with the antennæ enlarged at the tip (fig. 123). This section comprises a great number of species, usually of small size, but of great diversity of structure and habit. The tarsi in most of the families are five-jointed, but many of the smaller species have but three-jointed tarsi. The head is commonly much smaller than the thorax, and often bent under or partly depressed. Most of their larvæ are predaceous, but many feed on dead animals or vegetable matter, stored foods, in ants' nests, and a few on living plants. The larvæ exhibit very diverse characters, but usually they are more cylindrical than those of the Adephaga and with less prominent legs, and when there are terminal processes or tails they are less long than in the Adephaga. To this section belong the prettily spotted ladybird beetles (Coccinellidæ) (fig. 34) which are very beneficial to mankind, since both beetles and larvæ destroy countless thousands of aphides and scale insects. One of these, the famous Vedalia ladybird, destroyed the Icerya scale insect that was ruining the orange orchards of California.

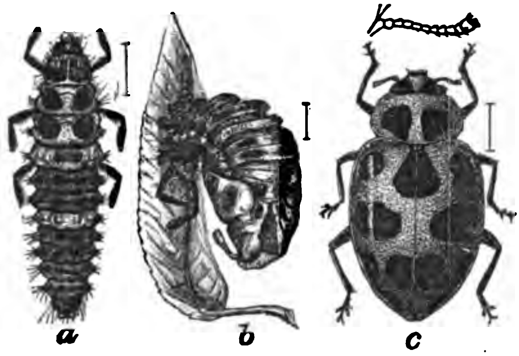

FIG. 34.—A LADYBIRD, MEGILLA MACULATA: a, LARVA; b, PUPA; c, BEETLE.

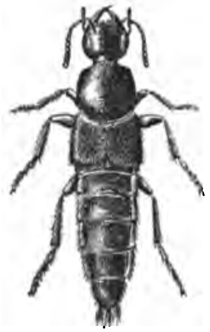

FIG. 35.—A ROVE-BEETLE, PHILONTHUS.

An immense family, the rove-beetles (fig. 35) (family Staphylinidæ), have long slender bodies, and the elytra are very short, not half covering the abdomen. The carrion-beetles (Silphidæ) (fig. 130) are common around dead animals; they are mostly broad and flat. Some species (family Hydrophilidæ) are aquatic, like the dytiscids of the previous section.

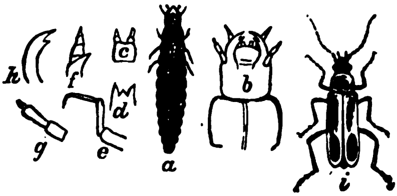

FIG. 36.—A SOLDIER-BEETLE, CHAULIOGNATHUS PENNSYLVANICUS: a, LARVA; b-h, PARTS OF LARVA ENLARGED; i, BEETLE.

The *Serricornia* includes a few families of beetles (fig. 36) in which the antennæ are not enlarged at tip but are serrate or saw-like beneath. The body is often elongate, with subparallel sides. The head is small, but distinct from above. The legs are quite slender, and the tarsi five-jointed. The adults are often found on flowers or on leaves, but do not eat much. Some of them are called click-beetles (fig. 37) (Elateridæ), since when laid upon their back they can spring into the air accompanied by a clicking noise. This section also includes the fireflies (family Lampyridæ), whose intermittent light on a summer evening is familiar

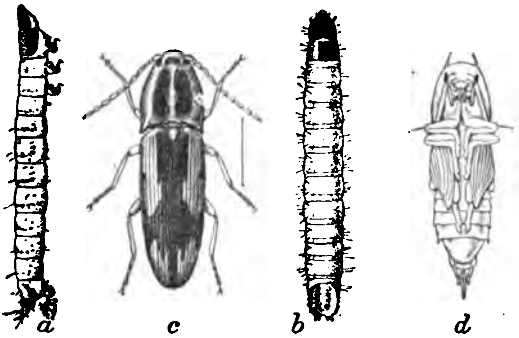

FIG. 37.—A CLICK-BEETLE, MONOCREPIDIUS VESPERTINUS: a, LARVA FROM SIDE; b, LARVA FROM ABOVE; c, BEETLE; d, PUPA.

to all. Many species are dull colored, but the Buprestes are among the most brilliant and gorgeous of the insect tribe. The larvæ of this section are variable. Those of the Buprestes (figs. 38, 126) bore in wood, have enlarged heads, and are without legs. The larvæ of other families, however, have short legs, and in many cases the last segment is corneous and toothed. Some of them are predaceous; others live in decaying or in living wood.

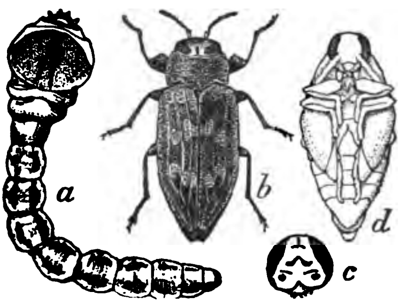

Fig. 38.—A Buprestid, Chrysobothris femorata: a, Larva; b, beetle; c, head of male; d, pupa.

Heteromera. — This section includes those beetles whose antennæ are simple (not clavate or serrate), and which have but four joints in the hind tarsi, the tarsi of the anterior legs having five joints. The ventral side of the abdomen shows but five segments. The beetles of this section are of various shapes. Many of them are dull colored. The head is usually prominent, and the legs quite slender. Some of them have no hind wings. Most of them feed on vegetation, others in stored foods, and some (Meloidæ) are parasitic in the nests of wasps, bees, or on the eggs of grasshoppers. The latter pass through a complicated life history, the first larva looking much like that of the Adephaga, while later the larva is a fat grub like that of the June bugs. Other larvæ are hard-bodied and rather slender. To this section belong the blister-beetles (Meloidæ) (fig. 118) and the mealworm (Tenebrionidæ, fig. 39) and the small flower-beetles (Mordellidæ), with compressed tapering bodies, which slip through the fingers when one catches them.

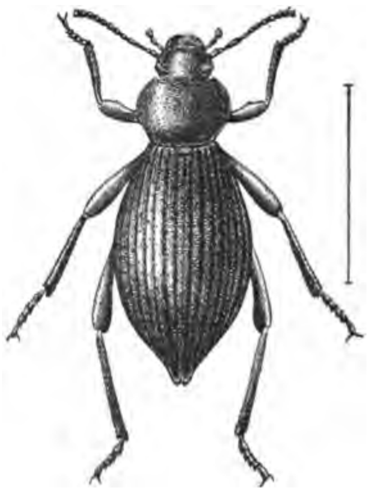

Fig. 39.—One of the Tenebrionidæ, or darkling beetles, Eleodes.

Phytophaga.—This section includes a large series of beetles (fig. 40) in which the tarsi are apparently four-jointed, the basal three usually provided with dense, short hairs forming a sort of cushion. The head is usually bent downward, and the mouth is below. The antennæ are simple, and often very long. The legs are short and stout. In some cases the hind pairs are thickened for leaping. The larvæ of all feed on plants, either on the leaves, in the wood, or on the seeds. The adults in many cases also feed on the same materials. Many of them are very prettily marked with spots and stripes of various colors. A considerable number can make noises when disturbed. Most of their larvæ have short legs, but some of the wood-boring kinds are apodous, or legless. In nearly all the last segment is not corneous or toothed, but in one group of leaf-beetles (Cassidæ) the last segment, as well as other segments, shows a marvelous development of spines and projections. The long-horned beetles (Cerambycidæ) (fig. 120), the leaf-beetles (Chrysomelidæ) (figs. 121, 124), of which the potato "bug" (fig. 41) is an example, and the bean and pea weevils (Bruchidæ) (fig. 125) belong to this section.

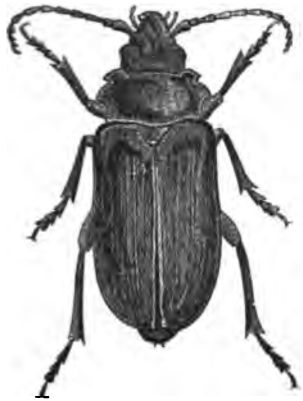

FIG. 40.—A LONGICORN, PRIONUS LATICOLLIS.

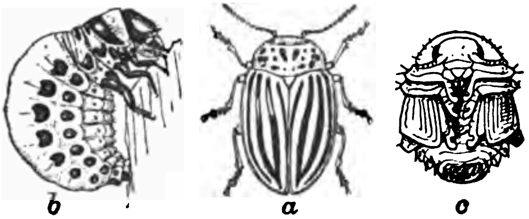

FIG. 41.—THE COLORADO POTATO "BUG," LEPTINOTARSA 10-LINEATA: *a*, BEETLE; *b*, LARVA OR GRUB; *c*, PUPA.

Rhynchophora, or weevils. This section comprises an enormous number of compact beetles, readily known by the snout or beaklike head, called a rostrum. The tarsi are four-jointed. The mouth-parts are very small and at the tip of the beak, and the antennæ are often slightly clavate and geniculate or bowed. The elytra are usually very hard, and in a number of species there are no hind wings. Most of them belong to two or three families, Curculionidæ (fig. 42), Calandridæ (fig. 119), or Otiorhynchidæ, but are similar in appearance. Both adults and larvæ are phytophagous, feeding on leaves, on the seeds, on fruits, in wood, or on plants. The larvæ are grublike, soft-bodied, usually curved, without legs or with only very short ones, and the last segment is not hardened or produced. The famous cotton-boll weevil (*Anthonomus grandis*), the plum curculio (*Conotrachelus nenuphar*) (fig. 43), the grain weevil (*Calandra oryza*), and many other injurious beetles belong to this section. They are very abundant in tropical countries, and often of very brilliant coloration. Allied to them are the Scolytidæ, barkbeetles, or engraver-beetles (fig. 161), which are very destructive to timber. They are small and dark colored, with

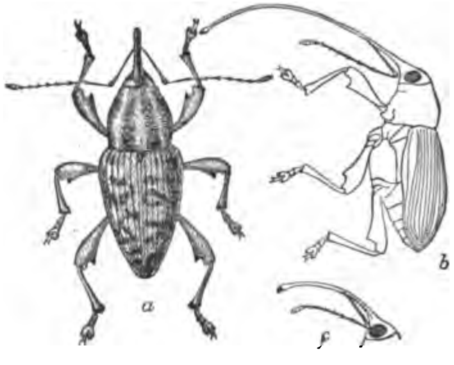

FIG. 42.—A CHESTNUT WEEVIL, BALANINUS RECTUS: *a*, TOP; *b*, SIDE; *c*, HEAD.

blunt head and knobbed antennæ. The burrows (fig. 162) of the beetles and larvæ in wood and under bark are often of a characteristic pattern for each species.

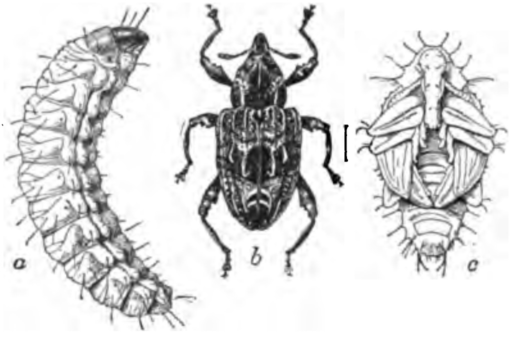

FIG. 43.—THE PLUM CURCULIO, CONOTRACHELUS NENUPHAR: *a*, LARVA; *b*, BEETLE; *c*, PUPA.

Lamellicornia.—The beetles (fig. 44) of this section have the last few joints of their short antennæ developed into leaflike extensions. The tarsi are five-jointed. Many of them are of large size (fig. 122), with broad, heavy bodies, and in many cases the males have curiously developed horns on the head or prothorax. Their legs are rather short, and usually end in very stout claws. Some of them have the forelegs toothed and fitted for burrowing in the soil. Many of the tropical species are renowned for the beauty and elegance of their form and color. The larvæ are fat grubs, with very short legs, a prominent head, and a thick, soft abdomen. They often lie in a half-curled position. The adults are frequently found upon flowers, and many eat the leaves of plants. The larvæ live in the soil, feeding upon roots, or in manure, or in decaying wood, or in ants' nests. To this section belong the sacred Scarabæus of the Egyptians, the familiar June-bugs or May-beetles (family Scarabæidæ), and the stag-beetles (Lucanidæ), the males of which have enormous jaws.

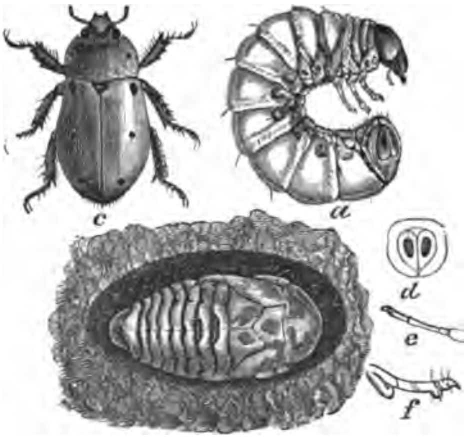

FIG. 44.—A LAMELLICORN, PELIDNOTA PUNCTATA: *a*, LARVA; *b*, PUPA; *c*, BEETLE; *d*, *e*, *f*, ENLARGED PARTS.

STREPSIPTERA.

This order (family Stylopidæ) includes a few tiny insects whose curious structure and habits have long puzzled entomologists. The male has large eyes and a short, small abdomen. The elytra are very rudimentary. These males live but a short time, but are very active. The female is a mere sac, a head and a larger body, without legs and wings. The larvæ and the female live in the bodies of other insects, wasps, bees, and certain Hemiptera. They pass through a complicated metamorphosis. The first larva, called a triungulin, is a minute insect with six long legs and a pair of bristles at tip of body. All stages should be mounted upon slides.

TRICHOPTERA.

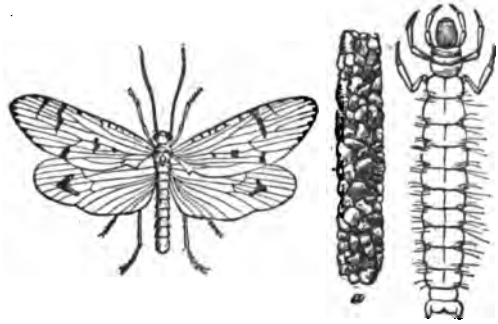

FIG. 45.—A CADDICEFLY, LARVA, AND ITS CASE. (FROM PACKARD.)

This order includes the caddiceflies (fig. 45), or watermoths. They have a general resemblance to moths, or millers, but have hairs instead of scales upon the wings and body. Many are attracted to electric lights. The antennæ are slender and simple, the hind wings broader than the fore pair, and the posterior part folds as a fan. The adult insects have very weak mouth-parts and take no nourishment. The larvæ and pupæ live in the water of ponds and streams. Many of them make cases of pebbles, sticks, or leaves, which they carry about with them. Others spin a web or net in the water. The former live upon aquatic vegetation; the latter are predaceous. They pupate within their cases, closing up the entrance with a mesh of threads. None of them are of economic importance, and they are most abundant in the colder parts of the country.

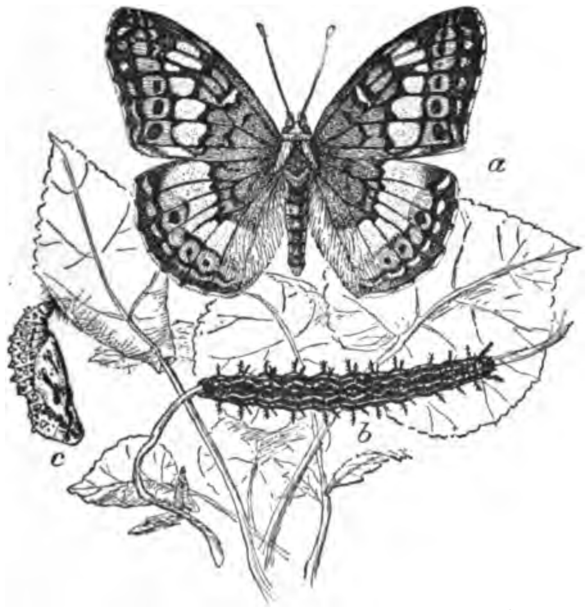

FIG. 46.—A BUTTERFLY, EUPTOIETA CLAUDIA: a, ADULT; b, CATERPILLAR; c, CHRYSALIS.

LEPIDOPTERA.

This order comprises the butterflies (figs. 46, 131, 132) and moths, or millers (figs. 133, 134, 158). The handsome colors of many species have made this order the most popular one with entomologists. The metamorphosis is complete, and the transformation from the pupa or chrysalis to the butterfly has been a marvel to all observers, and frequently applied to human life. The beauty of these frail insects is due to the scales that cover the wings and body. These scales are of various shades and structure, and so placed as to overlap each other. Their colors range from the most brilliant to the most delicate, and often display a glittering iridescence unapproachable by any human artifice; and the pattern in which the colors are arranged is often of the most attractive and exquisite design, the delight of childhood and the admiration of age.

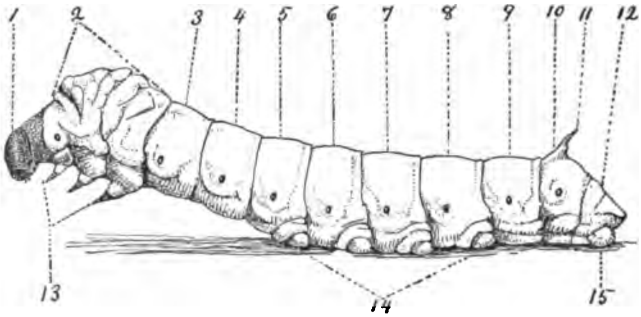

FIG. 47.—A CATERPILLAR: 1, HEAD; 2, THORAX; 3 to 10, SEGMENTS OF BODY; 11, HORN; 12, LAST SEGMENT; 13, TRUE LEGS; 14, FALSE LEGS OR PROLEGS; 15, ANAL CLAWS.

The mouth-parts of the Lepidoptera are modified to form a long proboscis, haustellum, or sucking tube, which is usually carried rolled up under the head and hidden by scales. In some species, as the hawk moths, this proboscis is very long, so that the moth may hover in front of a flower, insert the tube to the bottom of the flower, and extract the nectar. The young, or caterpillars (fig. 47), are of very diverse appearance, but usually elongate, with a distinct head and three pairs of legs. Behind these true legs are several pairs of fleshy prolegs, which assist in crawling. These are from four to ten in number. These caterpillars are often provided with hairs, bristles, or spinous projections. All (with a very few exceptions) feed on vegetation, usually living plants, and consequently do a great deal of damage.

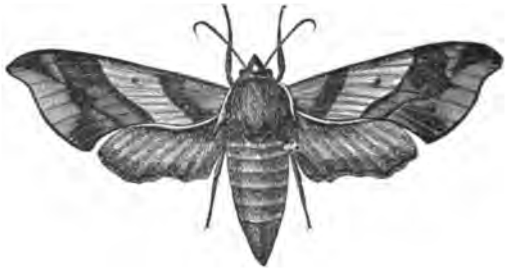

FIG. 48.—A SPHINGID, AMPELOPHAGA MYRON.

The generally accepted division of the Lepidoptera is that of butterflies (Rhopalocera) and moths (Heterocera). The butterflies as a rule have the antennæ clavate or knobbed at tip, hold their wings erect when at rest, fly by day, and they do not spin a cocoon to inclose the pupa, which is placed above ground. Many of the butterflies have common names; the large "swallow-tails" (Papilios) are known to every country child. One family of the butterflies, the Hesperidæ, or "skippers," have the antennæ terminating in a point, and some entomologists believe they should form a third primary division called Grypocera.

The moths have the antennæ of various shapes, but not knobbed at tip. The wings are usually depressed at rest. They are mostly nocturnal in their habit, and the pupa is usually within a silken cocoon spun by the larva. The Sphinges, or hawk moths (fig. 48), are intermediate in habit, flying mostly at twilight, and their antennæ, although thicker near tip, terminate in a fine point much like those of

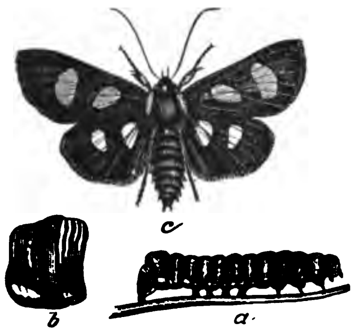

FIG. 49.—THE EIGHT-SPOTTED FORESTER, ALYPIA OCTOMACULATA: *a*, LARVA; *b*, ENLARGED SEGMENT OF SAME; *c*, MOTH.

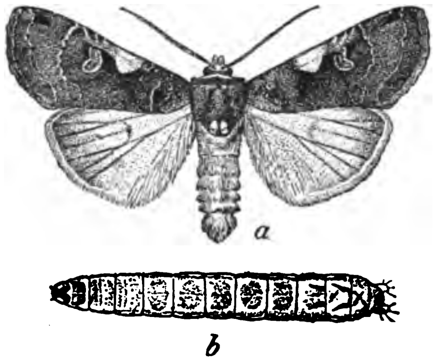

FIG. 50.—A CUTWORM MOTH, NOCTUA C-NIGRUM: *a*, MOTH; *b*, CATERPILLAR.

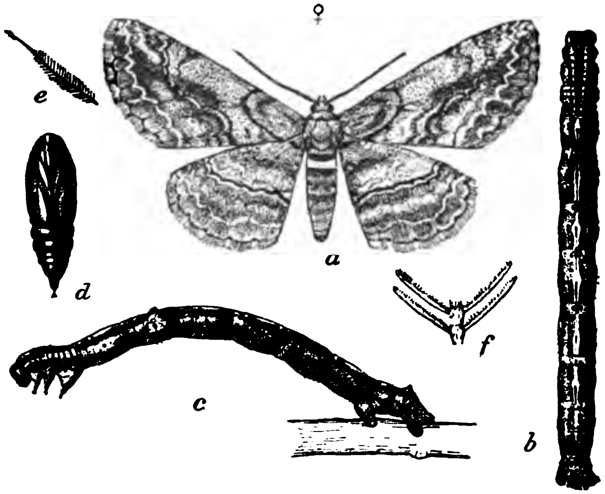

FIG. 51.—A GEOMETRID, CLEORA PAMPINARIA: *a*, MOTH; *b*, *c*, CATERPILLAR; *d*, PUPA; *e*, *f*, ENLARGED PARTS.

the "skippers." Their larvæ are large, smooth caterpillars, often with a horn near tip of body. The old group of Bombyces (fig. 49), now divided and scattered, included some of the largest species of the order. The pale green Luna moth and the American silkworm, or Cecropia moth, are well-known forms. The Io moth has a green caterpillar, which can "sting" when handled. The gipsy moth also belongs in this group, as well as the silkworm moth, which, next to the honey bee, is the most valuable insect. The caterpillars of this group are usually spiny or hairy. Allied are the Noctuidæ, or owlet moths (fig. 50). They are rather stout-bodied, of moderate size, with dark colors. The caterpillars are smooth, and often known as cutworms. Among them are many of our most destructive insects, such as the bollworm and the cotton leaf-worm.

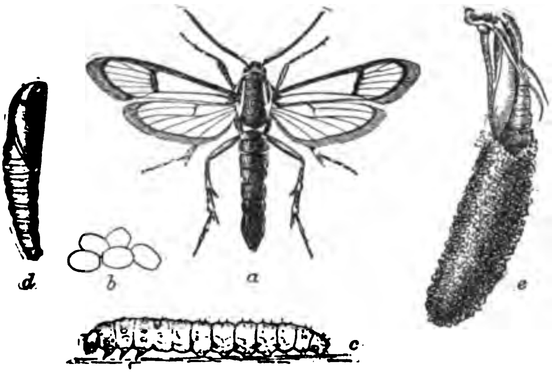

FIG. 52.—A SESIID, OR CLEAR-WINGED MOTH, SYNANTHEDON PICTIPES: *a*, MOTH; *b*, EGGS; *c*, CATERPILLAR; *d*, PUPA; *e*, PUPA IN CASE.

Another great group is the Geometridæ (fig. 51), whose larvæ have fewer prolegs than usual, and in consequence hump up their body when crawling, and so are called measuring worms. The moths have slender bodies and large wings, often of handsome shades and tints. The cankerworm belongs to this group. The slug caterpillars, which apparently have no feet and are often of curious shapes and bright colors, are the young of the Limacodid moths. One of these, the saddle-back caterpillar (fig. 135), will "sting" when touched, producing a sort of rash on the skin. The clear-winged, or Sesiid moths (fig. 52), are peculiar in that a part of the wings is destitute of scales. Their larvæ usually bore in the stems of plants and trees. The caterpillars of a small group of moths (Psychidæ) live in a case of leaves, which they carry about with them. One, the well-known bagworm (fig. 136), is often found upon evergreens, locust trees, etc.

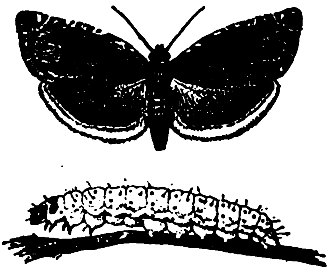

FIG. 53.—A TORTRICID MOTH AND ITS CATERPILLAR, SEMASIA NIGRICANA.

Several families of small moths (the Pyralidæ, Tortricidæ, and Tineidæ) are often grouped together by entomologists under the name of Microlepidoptera, or simply "Micros." The Pyralids (fig.

137) have rather triangular wings. Their larvæ often web up the leaves upon which they feed. The Tortricids (fig. 53) are known as leaf-rollers, since the larvæ of many species roll and fasten up the leaves, within which they feed and complete their transformations. Others, as the injurious codling moth, bore into fruit, stems, etc. The Tineid moths (fig. 54) are the most minute insects of this order, and many are of the most glittering colors. The larvæ of many kinds mine between the upper and under surfaces of leaves, forming sinuous lines or blisters. Others carry a case about with them, at least for a part of their lives. Their wings are long and slender, and their legs and palpi are often provided with dense brushes of scales.

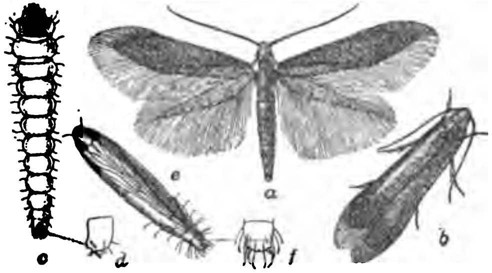

FIG. 54.—A TINEID MOTH, TISCHERIA MALIFOLIELLA: a, MOTH; b, SAME, WINGS CLOSED; c, CATERPILLAR; e, PUPA; d, f, ENLARGED PARTS.

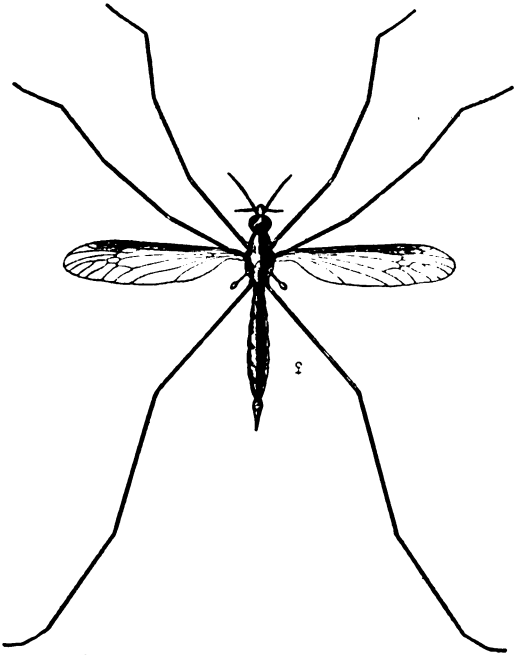

FIG. 55.—A CRANE-FLY, TIPULA INFUSCATA.

DIPTERA.

This order includes the true flies, those insects with but one pair (the anterior) of wings. The hind wings are replaced by a pair of short, slender, knobbed filaments called halteres, poisers, or balancers. The mouth-parts of Diptera are quite distinct from those of other groups, and formed for sucking liquids, but there is never a curled sucking tube like that of the Lepidoptera. The body is usually provided with hairs, bristles, or, in some cases, as the mosquitoes, with scales. The metamorphosis is complete. The larvæ are footless, and called maggots. The pupa is exposed, not in a cocoon, but in many forms the pupa is formed within the hardened larval skin. This is called a coarctate pupa. The larvæ of many forms live in water, or at least in moist surroundings.

The classification usually adopted for the flies is that of Nemocera for those having long antennæ, and palpi of four or five joints. The pupa is naked, not coarctate, and the larvæ usually have a very distinct head. The Brachycera have very short antennæ, and palpi of one or two joints. The pupa is often coarctate, and the larvæ usually have no distinct head. The further arrangement of the groups is very unsettled. The suborder **Nemocera** can be arranged in three sections:

(1) The *Polyneura* (family Tipulidæ, or crane-flies (fig. 55),) are known from all others by the V-shaped suture on the thorax. Their legs are excessively long and fragile, and the wings and abdomen are also slender. The larvæ are slender, and often occur in water or moist places. Some, however, are abundant in fields.

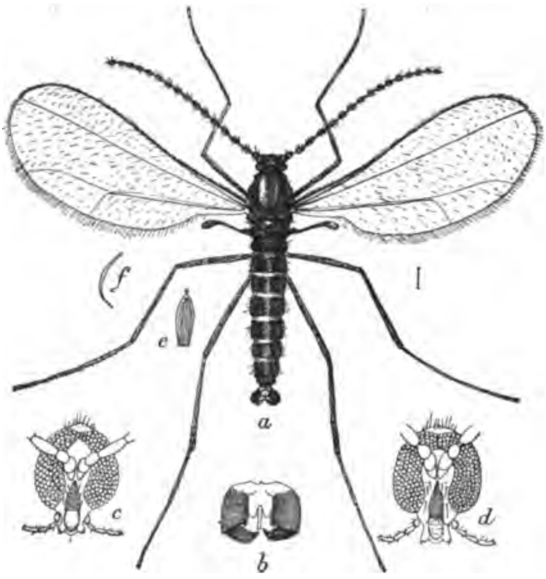

FIG. 56.—THE HESSIAN FLY, MAYETIOLA DESTRUCTOR: *a*, FLY; *b*, *c*., *d*, *e*, *f*, ENLARGED PARTS.

(2) The *Nemocera vera* have verticels or whorls of hairs on the antennæ. They have slender bodies and legs. The larvæ of the gall-gnats (Cecidomyiidæ) often produce galls on various plants. The Hessian fly (fig. 56) and wheat midge belong to this family. The Culicidæ, or mosquitoes, have scales on their wings. The larvæ (fig. 141) are aquatic, and familiar to most people as "wrigglers." Only the female mosquitoes can bite, and it is now known that several species transmit disease. The *Anopheles maculipennis* carries malaria, and the *Stegomyia calopus* (fig. 57) disseminates yellow fever. The Chironomidæ, or midges, with feathery antennæ, have aquatic larvæ, and the fungus-gnats (Mycetophilidæ), with long coxæ, breed in fungi, under loose bark, and in manure and decaying wood.

(3) The *Nemocera anomala* includes several small families which have no whorls of hairs on the antennæ, and in which the body and

wings are not slender. The black flies and buffalo gnats (Simuliidæ) belong to this group. They can bite very severely. Their larvæ occur in streams, and have long brushes near the head, and their pupæ have long filaments from the thorax.

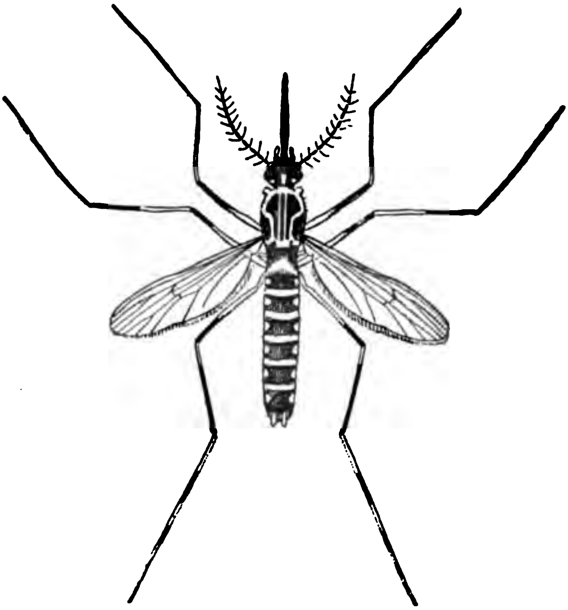

FIG. 57.—THE YELLOW-FEVER MOSQUITO, STEGOMYIA CALOPUS.

The suborder **BRACHYCERA** is divisible into four sections:

(1) The *Orthorrhapha*, which do not have a coarctate pupa. The larvæ have a distinct head, and the last joint of the antenna is often long and sometimes shows annulations, and there is no frontal lunule or suture over the base of the antennæ. This section includes our largest flies. They are arranged in three groups: (*a*) The Eremochæta, which have the median projection, called an empodium, between the pads or pulvilli on the feet similar in appearance to the pulvilli, and the third joint of the antennæ often shows annulations. There are no large bristles on the body,

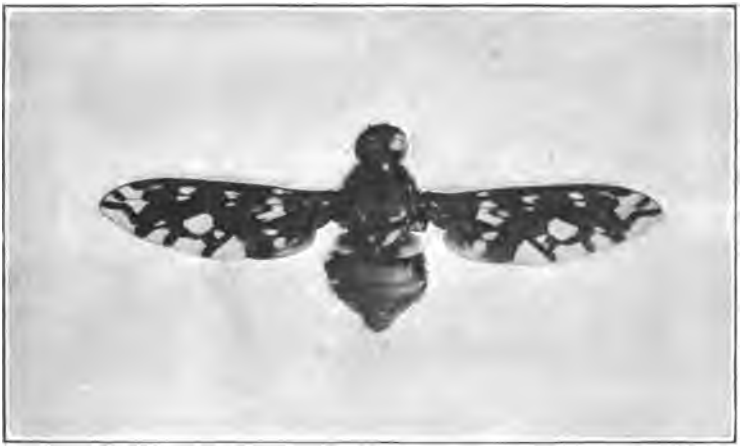

FIG. 58.—A BOMBYLIID FLY, SPOGOSTYLUM SIMSON.

and the legs are usually nearly smooth. The soldier-flies (Stratiomyiidæ), which have many markings on the body, the horseflies (Tabanidæ) (fig. 143), which annoy cattle as well as man, and the snipe-flies (Leptidæ), with slender, tapering bodies, belong to this group. Their larvæ are often aquatic, or live in moist situations. (*b*) The Tromoptera, or hovering flies, in which the empodium is bristle-like, much more slender than the pulvilli, or else absent. The third joint of the antennæ does not show any annulations. The legs usually have only fine hairs, and the body, especially the thorax, is often very hairy. The bee-flies (Bombyliidæ) (fig. 58), with pretty pictured wings, are in this group. Their larvæ are often predaceous or parasitic. (*c*) The Ernegopoda, which have strong, bristly legs, and often large bristles on the thorax. The empodium is slender or absent, and they are nearly all predaceous flies. The Asilidæ, or robber-flies (fig. 59), are the largest of these insects, while the Empididæ and Dolichopodidæ embrace a host of smaller forms.

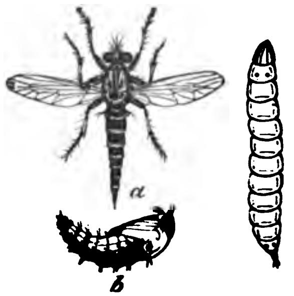

FIG. 59.—A ROBBER-FLY, ERAX BASTARDII: *a*, PERFECT INSECT; *b*, PUPA; LARVA SHOWN AT SIDE.

(2) The *Aschiza* have the antennæ composed of three joints, with a tiny hair or arista near the tip. The head has no distinct lunule or arched suture near the base of the antennæ. The pupæ are coarctate. This includes the large family Syrphidæ (fig. 156), many of which are brightly and prettily colored, and the thick-headed flies or Conopidæ, which have the abdomen narrowed at base. Many of the larvæ of the Syrphids are predaceous and feed on plant-lice; others occur in mud, in foul water, in ants' and wasps' nests, and in bulbs of plants. The larvæ of Conops are parasitic in wasps and bees.

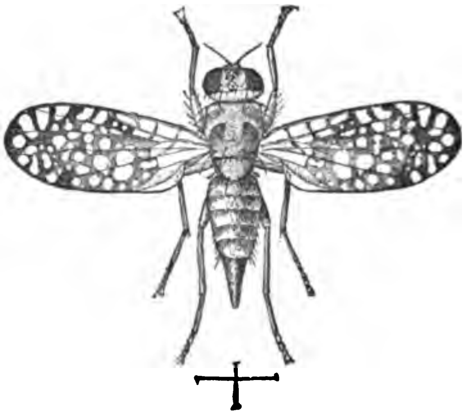

FIG. 60.—ONE OF THE TRYPETID FLIES, TRYPETA ÆQUALIS.

(3) The *Schizophora* have the pupa coarctate, the larvæ have no distinct head, and the antenna of the fly is of three joints and an arista, and the head shows a frontal lunule or arched suture near the base of the antennæ. This section includes two groups, one in which there is only one membranous piece or "calypter" each side above the haltere, the Acalypteræ; and the other group in which

there are two such pieces, the lower one much the larger, the Calypteratæ. The Acalypteræ includes many families of flies, mostly small and bristly. Some of them, like the Ortalidæ and Trypetidæ (fig. 60), have spotted or banded wings. Their larvæ occur in all sorts of places; some, like the apple maggot and the orange maggot, in fruit; others, like the frit fly, affect grains; others mine the leaves of plants, and many live in manure, or in moist soil.

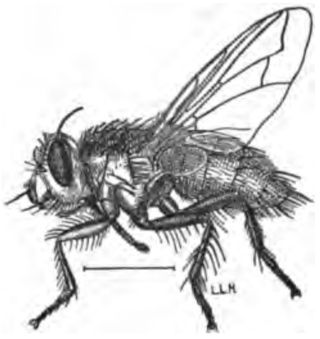

FIG. 61.—A TACHINA FLY, ARCHYTAS PILIVENTRIS.

The Calypteratæ include the Tachina (figs. 61, 157) and Sarcophaga flies, with a bristly abdomen, the larvæ of which usually are parasitic in other insects. The Anthomyidæ are smaller, and their larvæ often attack vegetables. The cabbage maggot belongs to this family. The Œstridæ (bot or warble flies) (fig. 62) are hairy species whose larvæ live in various animals, sometimes in man. The true Muscidæ (fig. 63) include the hornfly, blowfly, house fly, stable fly, screw-worm fly (fig. 142), etc. Many of them are injurious to man or animals. The African tsetse flies are responsible for the Nagana disease of cattle, and the sleeping sickness of man. The ubiquitous house fly is one of the most dangerous insects, since it is known to assist in the spread of typhoid fever and possibly other diseases. The larvæ of a considerable number are occasionally swallowed by man with food. Such are the Sarcophaga, blowfly, and the fruit worms, and may cause slight intestinal troubles. This false or pseudoparasitism of dipterous larvæ in man is called "myiasis."

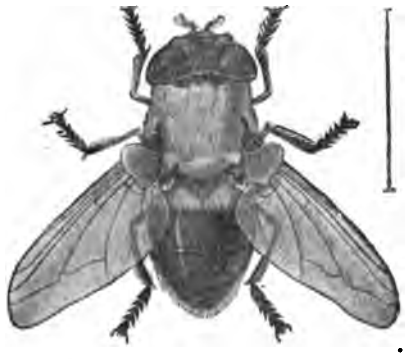

FIG. 62.—A BOT-FLY, CUTEREBRA CUNICULI.

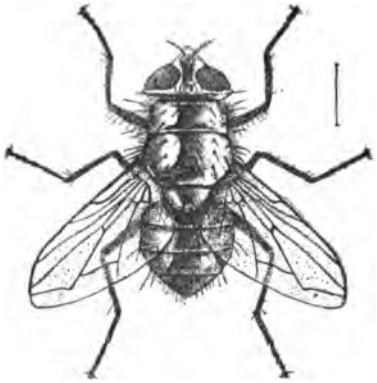

FIG. 63.—A BLUE-BOTTLE FLY, LUCILIA CÆSAR, A MUSCID.

(4) The *Pupipara* occur on birds, bats, and domestic animals. Many are wingless, all rather flattened, with large, strong claws. The young are produced alive, full grown, but have to pass through the pupal stage.

SIPHONAPTERA.

This order, comprising a single family, Pulicidæ, or fleas (fig. 64), is not a large one in point of species, but nevertheless manages to attract the attention of mankind. The fleas never have wings, but nature, always compensating, has endowed them with most remarkable leaping ability. The body is compressed, and the segments furnished with rows of bristles, and often some stiff spines. These spines are usually set upon the lower margin of the head and the posterior border of the pronotum, and each series is known as a comb or ctenidium. The antennæ are very short and lie in a groove near the small eyes. The mouth-parts are slender and suited for piercing the skin of the host and sucking up blood. The legs are very bristly, but not very large, and apparently incapable of producing the amazing leap. The larva of a flea is a slender, legless creature occurring under carpets, in cracks, near the nests of animals, etc., and feeds on refuse, dirt, and bits of decaying vegetable matter. When full grown they spin a cocoon within which they transform to the pupa, and later issue as adult fleas. In the past few years one of the rat fleas, *Xenopsylla cheopis*, has been connected with the dissemination of bubonic plague. Fleas may be taken from the host animals and in these animals' nests. All should be collected in vials of alcohol, and mounted in balsam on slides for study.

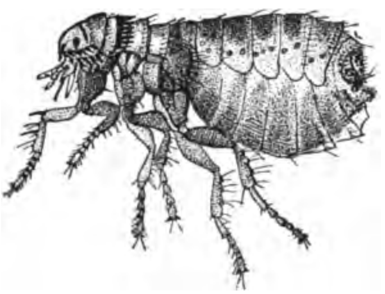

FIG. 64.—A FLEA.

HYMENOPTERA.

This order embraces a great number of insects, many of which are known under the names of bees, wasps, and ants. They have four membranous wings of moderate size, with but few cross veins, and biting mouth-parts. In some cases the mouth is also fitted for sucking or lapping up liquids, but the mandibles are still suited for biting. The body is very compactly put together, and the skin is often very hard, and in many cases the abdomen terminates in an ovipositor or sting. The thorax of most Hymenoptera comprises not only the three parts found in other insects, but also the first abdominal segment. The transformations are complete. The larvæ are usually footless, but those of the sawflies have six true legs and often prolegs which are more numerous than in lepidopterous insects. The Hymenoptera may be divided into suborders as follows:

The *Chalastogastra*, or sawflies (fig. 65), in which the abdomen is not constricted at base to form a petiole, and the first segment is not united to the thorax. The trochanter of the legs (the small joint between coxa and femur) is of two parts or joints. The tip of the female abdomen shows an ovipositor with pieces having a sawlike edge. The larvæ have three pairs of true legs, and often numerous prolegs. They feed on plants, and some species make galls on willow. There are two families, Tenthredinidæ and Uroceridæ.

The *Parasitica*, which includes an enormous series of species, the larvæ of which live in caterpillars or other insects (see fig. 139). They are therefore very beneficial. These have the abdomen slender at base, forming a pedicel, the first segment connected to the thorax. The trochanters are usually of two pieces. Many are slender insects with fairly long legs, and among them are many minute forms, some so small that one may be crawling across this page unseen by the reader.

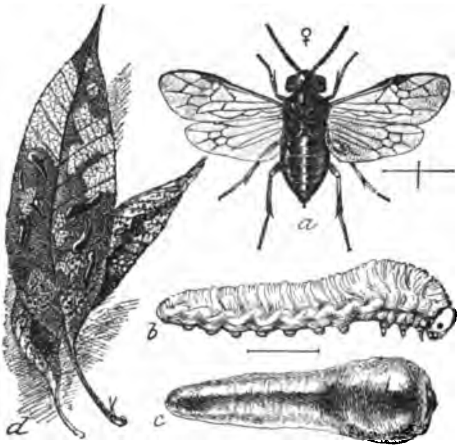

FIG. 65.—A SAWFLY, ERIOCAMPOIDES LIMACINA: *a*, FLY; *b*, *c*, CATERPILLAR OR SLUG; *d*, EATEN LEAVES.

The Proctotrypidæ are the tiniest of these forms; the young usually live in the eggs of other insects. The Chalcididæ (figs. 66, 67) are very numerous, and of variable habits; some live in the seeds of various plants, the jointworms in the stems of grasses, but most are parasitic on other insects. In some cases, although the parent lays but one egg in a caterpillar, several hundred flies may develop from it. The Ichneumonidæ (fig. 68) and Braconidæ (fig. 69) are closely related, and include the largest species. All are parasitic on other insects; many are prettily colored. The females of many species have long, prominent ovipositors, sometimes much longer than the body. Sometimes one of these parasites has a parasite upon it, the latter being called a "hyperparasite."

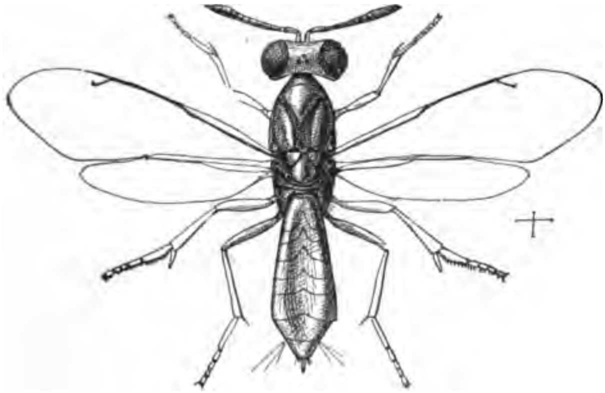
FIG. 66.—A CHALCIS-FLY, EUPELMUS LIMNERIÆ.

The Cynipidæ, or gallflies (fig. 70), are small insects, many making galls upon the leaves and twigs of plants, the larvæ living and developing therein.

The *Heterogyna*, or ants (Formicidæ), include a number of well-known insects whose industry and intelligence have excited the praise of observers in ancient times. In these insects (fig. 159) there are between the thorax and the main part of the abdomen one or two tiny segments with a knob or lobe above. The trochanters are undivided; the antennæ are often elbowed or geniculate. Ants live in communities of varying size, some of only ten or twenty individuals, others of many thousands. In most cases there are several forms—the winged male, the winged female or mother of the colony, the wingless neuters or workers, and in some cases there are soldiers which have enlarged heads or longer jaws. The larvæ are footless maggots fed and reared by the workers. In some cases they pupate within a silken case. Many kinds of ants can sting.

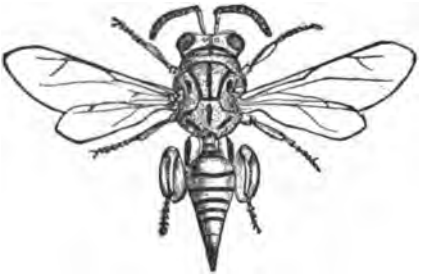

Fig. 67.—A Chalcis-fly, Spilochalcis mariæ.

Some ants make slaves of other kinds, the slave working willingly in the new colony. A few species store up seeds for the winter; others keep and protect plant-lice, from which they secure drops of nectar; others grow a sort of mushroom in their nest for food. Sometimes one colony will have a tremendous battle with a neighboring colony. Each ant of a nest can recognize any other member of that nest, no matter how numerous the colony, and they will fight any intruder from another nest. Several kinds of beetles, flies, and mites live in ants nests; these are called "myrmecophiles."

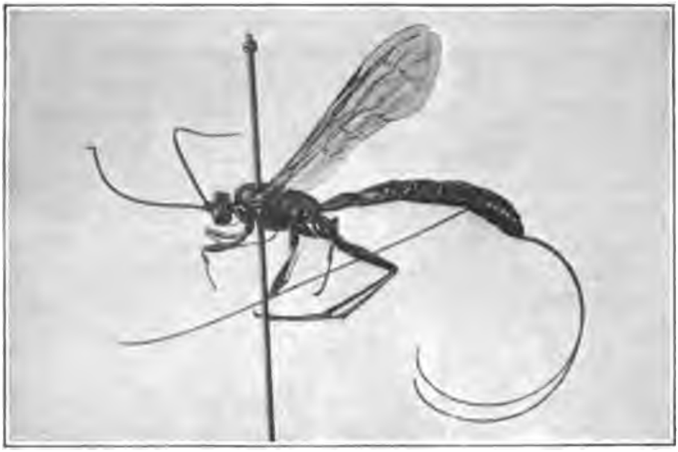

Fig. 68.—An Ichneumon fly, Ephialtes irritator.

The *Fossores* include the largest and most powerful insects of the order. These insects have a sting, the fore-wings are not folded, and the hairs of the body are not plumose. Most of them have rather large heads, long legs, and nearly bare body, which is often brightly colored. Some dig holes in the ground in which to rear their young. Others will tunnel in wood, and others prey cuckoo-like upon the other groups. They capture all sorts of insects and spiders, and store them in their nests for the food of the young. Many show much intelligence in preparing their burrows and in capturing, stinging, and storing their prey. Some of these wasps (Mutillidæ) have wingless females (fig. 71). The adults (fig. 140) can frequently be found upon flowers, upon the nectar of which they feed. The mud-dauber wasps (Sphegidæ) (fig. 72) belong to this group.

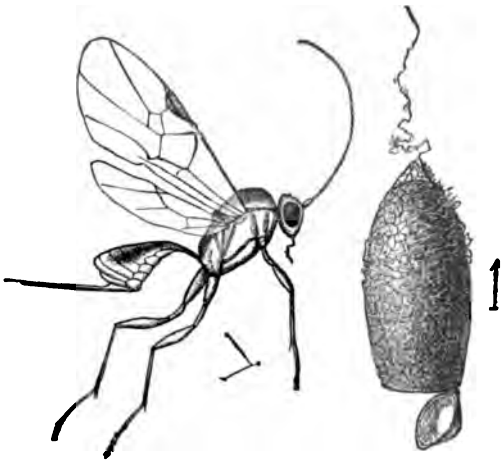

FIG. 69.—A BRACONID FLY, METEORUS HYPHANTRIÆ, AND ITS COCOON.

The *Diploptera* are stinging Hymenoptera in which the fore-wings can be folded longitudinally. The body is usually nearly bare, and the hind tarsi are simple. They are known as wasps. Some are social wasps (Vespidæ) (fig. 73) which make large nests in which to rear their young and which have three forms—the male, female, and worker. Others (Odyneridæ) are called solitary wasps, since they do not form colonies and there is no worker form, each female preparing a cell for her young. The paper nests of the white-faced hornet, one of the Vespids, are common in the woods of the Eastern States. Other species (yellow jackets) build nests in cavities in the ground.

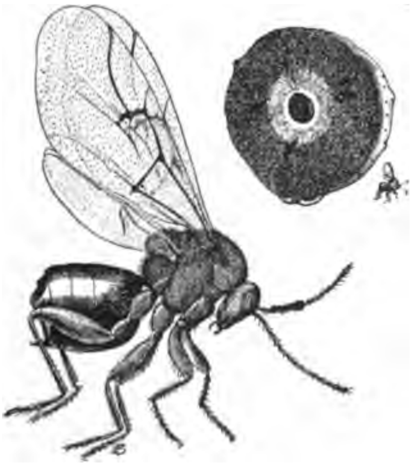

FIG. 70.—A CYNIPS AND ITS GALL.

The *Anthophila* includes the bees (Apidæ), stinging Hymenoptera, which are usually hairy and some of the hairs are plumose. The basal joint of the hind tarsus is elongate, and it and the tibia often fitted to carry pollen. The mouth of bees is provided with a tongue, sometimes quite long, with which to lap or suck nectar from flowers.

The young of bees are reared in cells which are constructed by the mothers. The food given is a mixture of pollen and honey. Some larvæ spin a cocoon, in which they transform; others do not. Quite a number of bees (fig. 74) are parasitic on their more industrious relatives, the adult laying eggs in the nest prepared by another bee, and her egg hatching before that of the rightful owner.

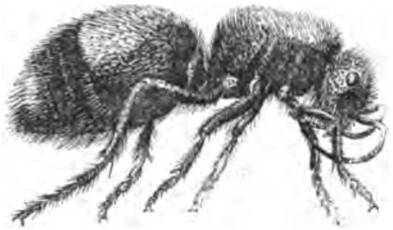
Fig. 71.—A Mutillid or stinging ant, Sphærophthalma occidentalis.

The honey bee is social, and there is a worker caste which builds the cells, collects the nectar and pollen, and cares for the young, the female or queen only laying the eggs. The bumblebees are also social, and make their nests in the ground; a female that has hibernated starting a new nest each spring. But most bees are solitary; that is, each female makes a nest for herself in the soil, in wood, or under stones. One of these, the leaf-cutter bee (*Megachile*), cuts pieces of rose leaves with which to line her nest in a hollow of soft or rotten wood. Bees are the principal factor in the fertilization of all flowers that have colored petals. Indeed, in some countries where they have no bumblebees they can not raise clover seed until they have imported these bees.

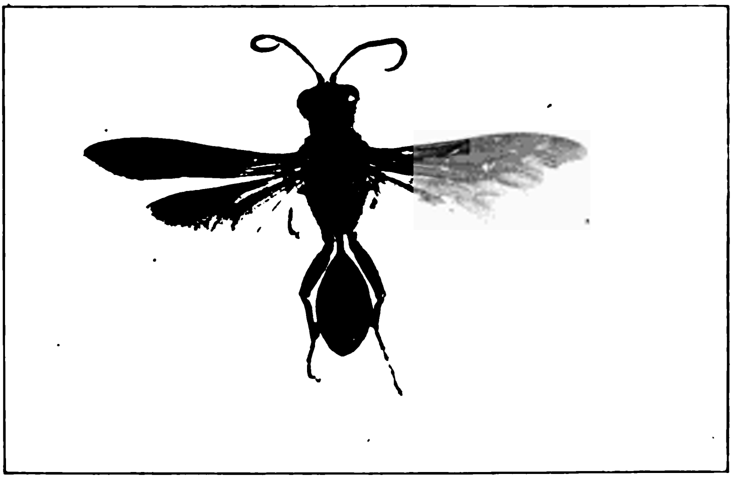
Fig. 72.—A fossorial wasp, Sphex ichneumoneus.

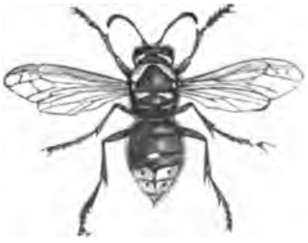
Fig. 73.—The white-faced hornet, Vespa maculata. (After Sanborn.)

COLLECTING APPARATUS.

Nets.—The essentials of collecting are a net, a killing bottle, pins, labels, and a box in which to keep the specimens. Practically every entomologist uses an insect net. This consists of a handle, a ring, and to the latter is attached a net. One can find a number of different forms in the catalogues of the dealers. If desired, one can make a very serviceable net for himself. One way is to take two pieces of stout wire, each about 15 to 20 inches long, bend them half circularly (fig. 75, *c*), and at one end make a folding hinge having a check on one side (fig. 75, *b*); the other ends are bent and beaten into two square sockets (fig. 75, *f*), which fit to a nut, soldered into one end of a brass tube (fig. 75, *d*). When so fitted, they may be securely fastened by a large-headed screw (fig. 75, *e*) which fits into the nut sockets. A handle may be cut and fitted into the hollow tube (fig. 75, *d*), which should be several inches long.

FIG. 74.—A BEE, EPEOLUS REMIGATUS.

A net with entire ring may be made by bending a piece of stout wire into a circle, leaving an inch or so at the end. These ends may be bound together tightly by smaller wire and then tinned by applying a drop of zinc chloride; then hold these ends in a fire or gas jet until red hot, and a few drops of solder placed upon the ends will join them firmly together. A brass tube, or rifle cartridge with end cut off, may be used to hold these ends. The tube should first be tinned with a little zinc chloride; cork up one end of the tube, then fill it with melted tin or soft solder, and insert the ends of the ring. When cold the cork may be removed and a suitable stick inserted.

Another way to make a simple ring is to bend a stout wire into a circle, leaving a few inches at the end, fully one-half inch of the extreme ends again bent as in the figure 76. Near the end of a stick two small holes are made, large enough to hold the bent ends of the wire. These are inserted into the holes, and then the ring is bound tightly to the stick by wire or stout cord; a groove cut in each side of the stick for the reception of the wire will make a better job. A winding mallet (fig. 77) may be used to wind the cord. The cord is wound around both mallet and stick and a turn or two around the handle; then, by turning the mallet around the stick, the cord is gradually wound upon the stick as tightly as the cord will stand. This mallet is useful to bind up a broken handle, if the break is oblique. Another plan of net is shown in figure 78; it is too heavy for anything but beating.

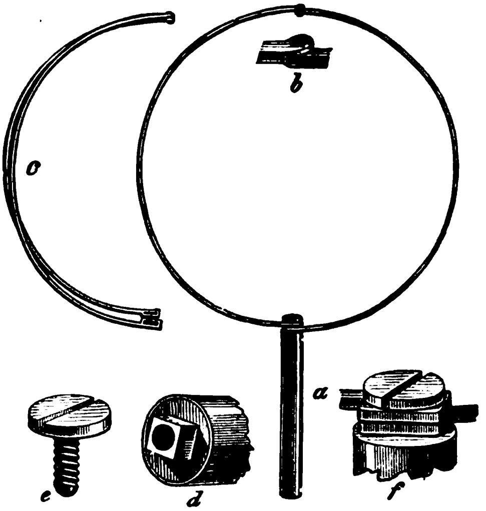

FIG. 75.—A BUTTERFLY NET-FRAME.

The various dealers in entomological supplies have a variety of nets, most of which are cheap and serviceable; one of the most popular is known as the "American" net. It will be best in the end to purchase a net. The size of the net varies with the purpose for which it is to be used. For general sweeping a ring of from 12 to 14 inches is sufficient. A beating net may be larger. For catching butterflies and dragonflies a net of 15 or 18 inches is better, provided this is not of too heavy material, for in catching these insects a rapid stroke is necessary, which is only possible with a light net.

For collecting small insects from flowers, bushes, etc., a midget net, 5 to 7 inches in diameter, is better than a larger net. This should be fitted to a short handle. A very handy one may be made by bending a piece of wire into a circle 5 inches in diameter, leaving an inch or so free at the ends. These may be inserted in the hole of a common spool and a short stick crowded in between them from the opposite end. Such a net may be carried in an ordinary coat pocket and put together in a few moments. Mr. Kearfott, for

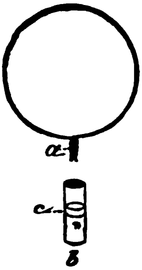

FIG. 76.—THE SANBORN NET-FRAME.

micros, uses a piece of spring brass wire, forming a net 6 inches across, leaving the ends straight. A hole is cut through a bamboo stick at the end, and the ends of the wire are inserted. Just before the holes the stick is wrapped tightly with stout cord to prevent splitting. For the net he uses white silk—a very fine-mesh silk veiling.

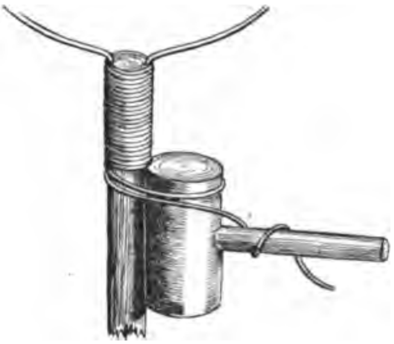
FIG. 77.—THE WINDING MALLET.

The handle of the net is of variable length and strength. For beating bushes it is necessary to have a very stout stick, hardly more than 2 feet long. For sweeping, the handle may be lighter and longer, 30 to 32 inches. For butterflies and dragonflies a bamboo handle is very good and may be 3 or 4 feet in length. Longer handles may be useful in special cases, and may be fastened to the ordinary handle. Most dealers make a jointed handle, which is a great convenience in packing, and one-half is about the proper length for beating.

The net may be of various materials. For butterflies a light net is the best; some thin material through which one can see the insect. Some use silk, or a silk gauze; some a material called "tarletan;" others prefer "bretonne net." What is known as cheese cloth, bobinet, or even mosquito netting does well for the beginner. For micro-lepidoptera, especially for a small net, a fine quality of silk is best; white china silk lining is good. Particularly in small nets one should

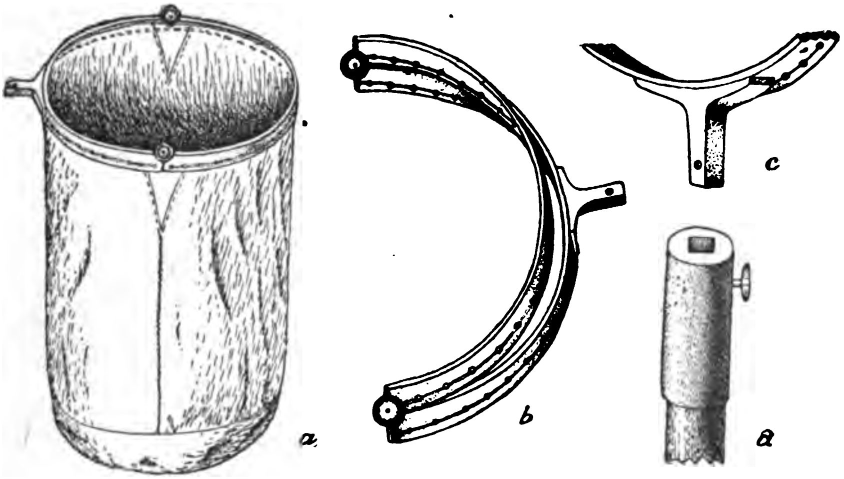

FIG. 78.—THE DEYROLLE SWEEPING NET: *a*, NET ENTIRE; *b*, FRAME; *c*, *d*, ATTACHMENT OF FRAME AND HANDLE.

use material which has not the slightest tendency to stiffen or kink. Some collectors use green or gray nets for Lepidoptera, but for general purposes a white net is the best. In length the net should be twice its diameter and should taper to the bottom. A sweeping net should be of stouter material, and where fastened upon the ring is sewed on to stout twill muslin. Some collectors fasten the net to small rings upon the main ring, as in figure 79. This saves the net from wearing out, as it is very apt to do when used much in dense brush. For beating a still stouter net is required; heavy twill muslin is good material.

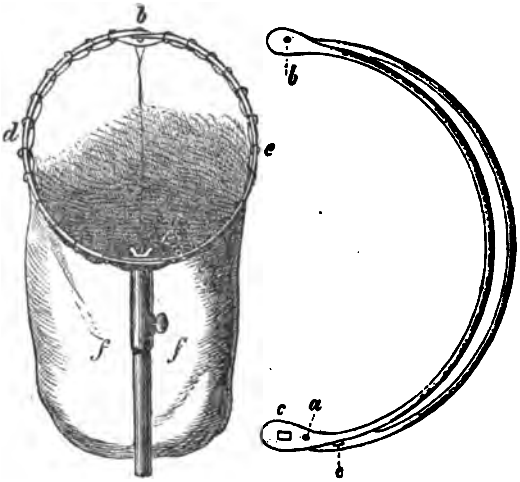

FIG. 79.—A BEATING NET, OPENED AND ATTACHED TO HANDLE, WITH FRAME OF SAME FOLDED. (AFTER KIESENWETTER.)

For aquatic collecting an open net (fig. 80) is preferable. A mesh of one-eighth inch is plenty large enough, as a larger mesh will permit the escape of many small insects. The water net should not be as long as the other kinds, and indeed may be very short (fig. 80). The top of the net may be covered by a coarse wire netting, either flat or conical, which will prevent plants and large débris from entering the net. For aquatic collecting, however, a dip net of wire mesh (fig. 81) is very useful, especially in collecting mosquito larvæ and other insects swimming in the water. With its sharp edge one may scrape insects from submerged stones. For insects in mud, among leaves on the bottom, among weedy marges, etc., a dragnet or a sieve net (fig. 82) is the right thing.

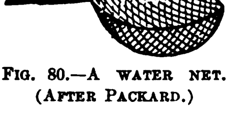
FIG. 80.—A WATER NET. (AFTER PACKARD.)

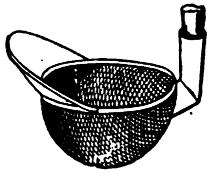
FIG. 81.—A SMALL WATER DIP NET.

Some collectors, particularly in Europe, have advocated the use of a scissors or forceps net (fig. 83) for small insects, but this is rarely used by American collectors. Mr. Conradi attaches to the forceps net, in the center of one of the nets, a tin tube one-half inch long, with outer end corked. When he desires to remove the insect the cork is taken out and the tube fitted into a cyanide bottle. A rattan net, made by some dealers, is very light and useful in capturing butterflies and other insects in flight.

What are known as "Simplex" nets are advocated by some entomologists. The ring is made of a piece of flat steel, which readily coils up, and may thus be carried in the coat pocket. The ends of the steel strip are fastened to the stick by various devices; usually by a ring or brass ferrule passing over them. These nets are, however, not as steady in use as one with stiff wire, but will last a long time and are cheap. They can be obtained in various sizes and with nets of several kinds.

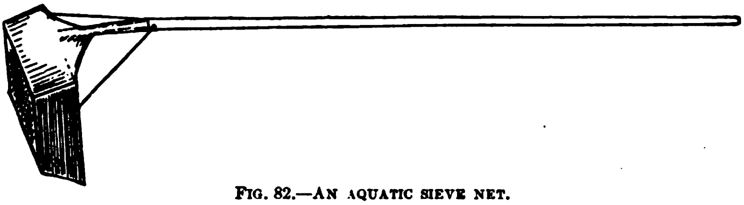
FIG. 82.—AN AQUATIC SIEVE NET.

Mr. Viereck has used with success a net made as follows: An ordinary insect net with an open bottom which has two rings close together. To this bottom is fastened a small bag with drawstring to close it tightly between the two bottom rings. The insects swept, fall into the bottom bag, which may be removed and placed in a cyanide jar. Another small bag is put on the net, and one can go on collecting while the first lot of insects is being killed by the cyanide. This apparatus will be especially useful in collecting Homoptera.

The umbrella.—An umbrella can be used to great advantage in collecting insects from foliage and dead twigs. If the handle is jointed, as shown in the illustration (fig. 84), it is more convenient. The inverted umbrella is held in the left hand under the branch, and with a stick in the right hand one can suddenly jar the branch, so that the insects clinging to the leaves or twig will be dislodged and fall into the umbrella. The branches should be jarred vertically and not horizontally, else some insects will be thrown beyond the umbrella. A curved handle to the umbrella is best, as with it one may often reach and pull down a bough, while a suitable stick is not always quickly found. A small cyanide vial with a quill through the cork is the best instrument to take insects from the umbrella.

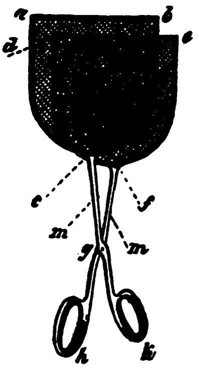

FIG. 83.—A FORCEPS NET. (AFTER KIESENWETTER.)

A substitute for the umbrella, and in many cases better than it, is the beating cloth. It consists of a piece of common unbleached cotton cloth, 1 yard square, to each corner of which a loop of stout twine is sewed, or a corner turned over. Upon reaching the woods, two straight sticks, each about 5 feet in length, and not too heavy, but also not so small as to break or bend too easily, are cut from a convenient bush. The sticks are placed crosswise over the cloth and fastened to the loops at the four ends. This is easily and quickly done by making sliding loops of the simple loops. The cloth is thus kept spread out between the sticks. To the center of the sticks another stick may be fastened, so as to hold the cloth out under the branch.

The sieve.—This consists of a wire sieve, to which is secured a cylindrical bag or net (fig. 85). Masses of fallen leaves may be taken up and dumped into the bag, and when shaken the insects will fall through upon a white cloth or stiff paper placed on the ground for this purpose. A good size for the sieve is a foot in diameter. The meshes should not be over one-fourth inch, and for sifting some materials one-eighth inch. In using the sieve one must not shake it too long before examining the cloth, else there will be so much débris as to obscure the insects. Many insects, when disturbed in this way, will play "possum," and it is therefore necesary to leave the cloth a few moments to give these coy insects a chance to start in motion. Two cloths laid a few feet apart and used alternately will effect this purpose. In cold weather one may so place and incline the cloth or paper that the sun will strike and warm the dormant insects into activity.

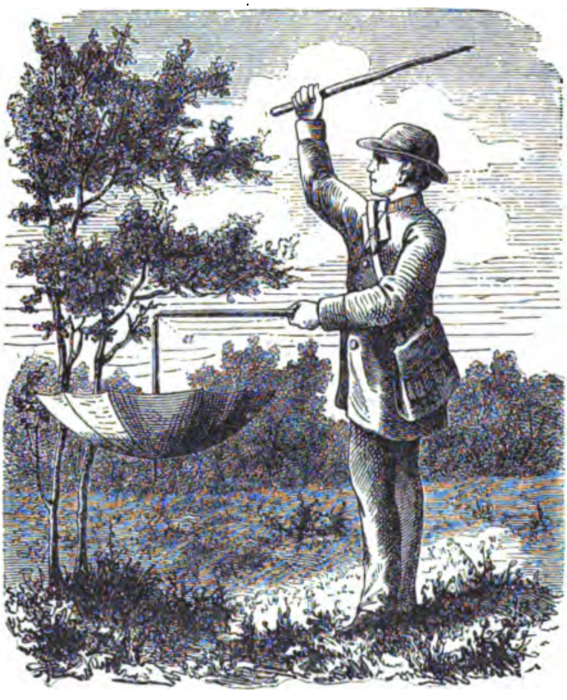

FIG. 84.—THE UMBRELLA AND ITS MODE OF USE. (AFTER KIESENWETTER.)

Besides dead leaves, the sieve may be used to get the insect forms from moss, ants' nests, old decayed trees, etc. One will be surprised at the great number of forms that may be gathered by the judicious use of the sieve. Many larvæ may be found, and a vial with a toothpick wet with glycerin will be handy to pick up the minute springtails and other forms. In winter one may gather likely material in sacks and carry it home, there to sift it at leisure. The larger amount of material may be usually secured from wet localities, but other forms will be found in dry places. Unpromisisng spots, though not furnishing so many insects, may often give something not elsewhere obtainable.

Various other methods have been devised to obtain the small insects found in fallen leaves, moss, etc. Hot water funnels are supplied by several dealers, and a "Photo Klector" is sometimes used in Europe. The latter is a flat triangular box with glass at one corner and a hole near by. To this hole is attached a glass jar. A rack with a sieve is placed inside, upon which is put the moss, leaves, etc. The insects crawl out, fall through the sieve, and walk along the bottom to the light in the glass corner, then fall through the hole into the glass jar. A more elaborate apparatus is the Berlese collecting cage (fig. 86), described by Doctor Howard as follows:

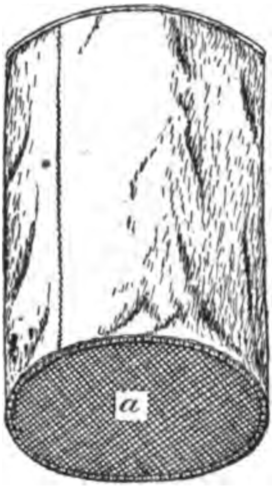

FIG. 85.—A SIEVE: a, WIRE NETTING.

> While visiting the laboratory of Prof. Antonio Berlese in Florence, in June last, I was greatly interested in an apparatus which he has prepared for collecting small insects and other arthropods very rapidly and in very great numbers, and which it seemed to me obviated in large measure the laborious process known to entomologists as "sifting." He showed me the apparatus practically in operation, and showed me, further, large numbers of vials filled with Thysanura, Myriapoda, Acarina, and the like, which in number and variety afforded a perfect revelation to me. Since returning to this country I have had one of the smaller styles of the apparatus made, and have tested it during the month of December with leaves and rubbish collected on the grounds of the Department of Agriculture and with very considerable success; so much so, in fact, that I wish to bring the apparatus to the attention of English-speaking entomologists. No doubt had I used leaves or top soil of old and long undisturbed wooded regions the results achieved would have been vastly greater than they have with the material tested; but even this, as just stated, has been very satisfactory. Professor Berlese's description and statement concerning results was published in Redia, Vol. II, No. 1, shortly after my visit, and his article, very freely translated, is as follows:
>
> Within this last year I have devised an apparatus which is very simple and very effective, with which I collect in great numbers and without fatigue, the small Arthropods as well as insects of all the following orders: Myriapoda, Symphyla, Pauropoda, Chelifera, and Arachnida, and especially Acarida, however small, without any danger of being able to escape. Of the Collembola, which are so difficult to collect because they spring, I have taken a very great number.
>
> All those living creatures which are found to be present in the mosses, among the dead leaves under the trees, in decaying wood, in humus, in decomposing substances, etc., are collected in a tube containing alcohol, which is attached to the apparatus under discussion, and on the part of the naturalist there is no further trouble than to separate them and study them. The apparatus consists of a large funnel which slides into a glass tube containing alcohol and this funnel is surrounded by water heated to

60° to 100°. On top of the funnel there is placed a sort of square tray of metallic network (a sieve) upon which is placed the material to be examined, and this material should naturally be sufficiently humid to restrain the living insects from escaping. Whether the material in the tray, passing gradually (although rapidly enough) through and losing some of its moisture causes the insects to fall to the bottom, or whether these are attracted by the heat beneath, it is certain that they all try to reach the metallic net and there they pass through, falling into the metallic funnel.

But the walls of the funnel, thanks to the water surrounding them, are so warm that the insects can not remain, and they fall, rolling downward until they enter the tube containing alcohol, in which only a very small quantity of detritus is collected.

It is necessary, however, not to shake or stir the apparatus or the material during this operation, to avoid the falling of too much detritus together with the insects.

The diameter of the funnel should be about a half meter, and the tray itself should be movable in order that it may be refilled with the material when separated from the funnel.

I have used to great advantage a small apparatus of this style (the funnel being only 30 centimeters in diameter) during the last year, and have thus discovered several new species of Italian Acarida, illustrated in this journal, while I have collected an enormous quantity of other small arthropods, especially of Collembola, Symphyla, Pauropoda, etc.

These, especially the Collembola, and also the Thysanura, all remain on the surface of the alcohol, not becoming submerged, while the other insects all fall to the bottom of the tube.

Thus, it is easy to collect the said Collembola with a brush from the surface of the alcohol without further disturbance.

After the excellent results secured from the small apparatus referred to, I had another, much larger, constructed which has been operated since November.

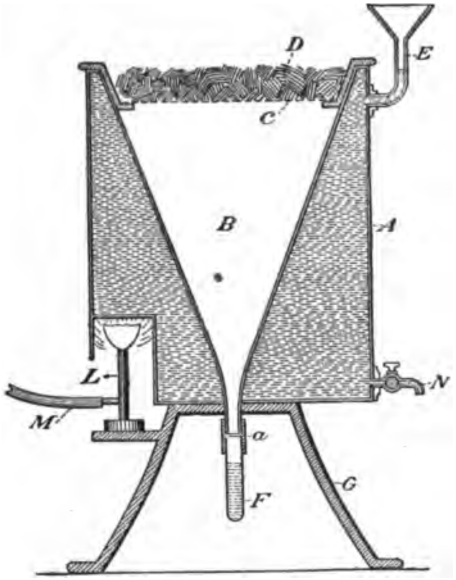

Fig. 86.—The Berlese collecting trap: *A*, exterior receptacle containing water; *B*, interior funnel; *C*, vessel having the bottom of metallic network; *D*, substance for examination; *E*, funnel for introducing the water; *F*, small glass tube containing alcohol, where the insects are collected, this being connected to the apex of the funnel by a short tube (*a*) of India rubber; *G*, feet supporting the apparatus; *L*, lamp for heating; *M*, India rubber tube for carrying off the gas; *N*, faucet for discharge.

It is composed of a case of wood, the interior of which is covered with lead, and has a capacity of 6 hectoliters, and contains four large funnels in square sections, the sides of which are 50 centimeters. Thus I have an extent of 1 square meter upon which to arrange the material for examination, and I can place four different kinds of material from four different localities on these sieves.

The water is about 3 hectoliters and is kept at 60° or 70°, and for some hours the temperature is maintained by means of a large gas heater.

This heater, which serves me well also for heating the room in which it is placed, consumes about 3 cubic meters of gas per day, which proves that, with an expense of about 1 lira, I daily obtain, without any trouble, a greater number of small insects than ten persons, with all the fatigue and patience possible, would be able to collect in the same length of time, and, besides, I have the assurance that scarcely an individual insect has escaped. (Entomological News, 1906, p. 49.)

Chisel, trowel, and hatchet.—These tools, of which a variety may be obtained at any hardware store, are useful in digging insects or larvæ from the ground, examining ants' nests, for loosening the bark of trees, and for cutting into trees to obtain wood-boring species. However, a good pocket knife can be used, though not so successfully, for this purpose.

Tin boxes and pill boxes.—One should, for general collecting or for gathering larvæ, take into the field a number of tin boxes and pill boxes. The tin boxes can be used for caterpillars and other larvæ, and a few leaves of the food plant may be inclosed with them. Coleopterous larvæ from rotting wood should be placed in boxes filled with the decayed wood, so that they will not shake around and injure themselves. Galls and leaves with mining insects should also be gathered in these tin boxes. Some dealers have for sale tin boxes especially made for collecting larvæ. Aquatic larvæ should be packed in tin boxes with wet moss, for they will die if carried long in a vial filled with water.

Lights and other traps.—Many insects can be obtained by various traps. These are principally lights and "sugaring," and are employed to attract night-flying insects. Many ground-loving species, however, can be trapped under pieces of bark, placed in likely situations, such as at the edge of meadows, cultivated fields, dense woods, along streams, etc. Particularly in the autumn, when many insects are seeking winter quarters, it will be found profitable to put out these traps. Dead animals will serve to attract necrophagous insects. Pieces of cloth may be wrapped around trees and examined from time to time, and will be found to harbor many insects. Tin cans or bottles sunk in the earth with the tops even with the ground will trap many larvæ and other insects. More elaborate traps may be readily made; for example, a large tin funnel with cyanide jar at end, and a central plate in top for a dead mouse, bird, or other carrion. Such a trap, buried in the ground with top even with the surface, will attract and capture quantities of beetles.

The use of lights in attracting moths and other insects has been followed by all entomologists, and a great variety of these lamps is obtainable from dealers. A strong portable lantern, hung so as to throw its light upon a white sheet, the latter supported by a couple of sticks, or suspended from a branch, will serve to attract a variety of nocturnal insects, and has the great advantage of being carried and set up anywhere in the woods. Many insects, upon reaching the light, have the habit of flying upward. If the white cloth is stretched upon a frame and set obliquely above the lantern many insects will alight upon it. Other insects, especially beetles, have the tendency to fly at the light and then fall. A tapering bag placed below the light, with the bottom opening into a cyanide jar, will secure these.

Many collectors have devised various forms of traps to capture the insects that come to the light. One (fig. 87) is by Professor Gillette. It is in three parts, all of bright tin. The funnel is 22 inches in diameter, the tube 2½ inches. This tube fits into the top of the reservoir below; the latter has a removable bottom. The reservoir is nearly filled with loose excelsior. The bottom is removed, and in its place is put a wide-mouthed glass bottle half full of cyanide. The cyanide should be slightly moistened and a piece of paper or wire mesh placed over it. The apparatus can be suspended in a tree or placed on a stand, and a large lantern hung over the top of the funnel so that the blaze will be just above the top of the funnel. It is well, on good nights, to empty the reservoir before leaving it for the night. This is done by taking out the excelsior and insects, placing them in cyanide bottles, and putting new excelsior in the reservoir.

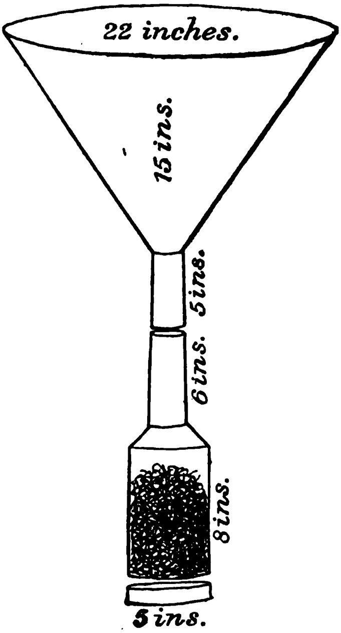

FIG. 87.—THE GILLETTE TRAP LIGHT.

The apparatus used by Mr. Morse is described by Mr. Smith as follows: It consists of a box of wood, having glass on each of its four sides and a cover with arrangement for outlet of heat and smoke similar to old-style street lanterns. At the bottom are holes for the ingress of air. The box is large enough to contain an ordinary kerosene lamp with chimney and is supported over a wooden box about 18 inches square, which in turn contains a zinc pan about 2 inches deep and as large as will go into the box. At the base of each pane of glass is a slot the whole width of the glass and about 1 inch wide, which opens directly into the pan below. The pan is filled about half full with water and then about a pint of kerosene is poured on top. The moth strikes the glass and falls through the slot and is killed by the oil. In the morning he takes a good-sized pasteboard box, in the bottom of which is about a dozen thicknesses of old newspaper and with a slender pair of forceps picks the moths out by the legs and lays them on the paper. They are left there for about two hours to get rid of most of the oil and water; then put in a large shallow pan of gasoline and covered with a pane of glass and left for some hours, frequently over night. Then pick them out and lay on blotting paper and the gasoline soon evaporates, leaving the moths clean and bright as though never wet.

Another light trap is shown in the accompanying illustration (fig. 88). It consists of a box larger in front than behind and attached behind to a lantern. Within the box are three panes of glass, placed obliquely (two will do). The moth flying against the outer pane rises and enters, then falls and enters beneath the second glass; as it hits the side of the lantern it falls into the cyanide jar beneath. In case it does not fall at once, it does not readily escape owing to the position of the glass panes. The back of the lamp box should be hinged with cloth so that the light may be readily inserted and removed. The cyanide jar can be attached by cloth or screwed in. The great advantage of these light traps is that they work over night. It is best to paint the inside of these traps white and the outside black or green. A pint Mason jar may be used for the cyanide jar, the top with center cut out fastened to trap, and jar screwed up into it. A bottomless tomato can may be used for the smoke vent, and the panes of glass can be held in place by strips of upturned tin or by nails. Anyone who desires to form a collection of moths will find some form of light trap indispensable.

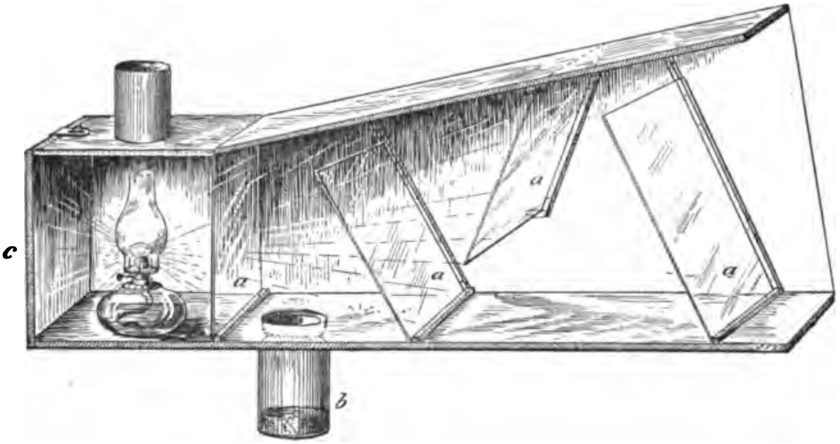

FIG. 88.—THE BROOKLYN LIGHT TRAP.

Sugaring.—Many insects, especially moths, have a fondness for sweets. Entomologists have taken advantage of this by smearing some sweet mixture upon the trunks of trees. This is known as sugaring. The mixture should be placed on the trees at twilight, and upon a number of trees. If there is a breeze the sugar should be placed on the leeward side of the trees. Then as darkness comes on one may go from tree to tree, and by the aid of a lantern (a dark lantern is usually preferred) secure the moths or other insects. A mixture of sugar and vinegar, or sugar and molasses, to which is often added beer or some other alcoholic liquor, is most favored by collectors. A mixture of sugar and rotten apples, or other decaying fruit, is extremely good. Warm, moist, cloudy nights are the best for sugaring, but one can not always be sure of a good catch, as insects sometimes come when least expected, and seemingly most favorable conditions are often unprofitable. One should take several cyanide bottles upon a sugaring trip, so that it will not be necessary to put many insects in one bottle. A net can be used to take those that fly around, and if the light is thrown upon the net many moths will rest upon it.

Some prefer to have one or two chloroform bottles with which to capture the specimens, and then when they have become quiet put them in the cyanide jar. Mr. Caudell devised a cloth funnel for catching quantities of moths. The bottom of the funnel was fastened by a rubber band to a large cyanide jar; the top had a wire or steel ring, but open on one side; this opening enables the collector to fit the top of the funnel to a tree or around a corner. Approaching a bevy of moths at the sugar the edge of the funnel was applied closely to the bark beneath them, and a puff would send the moths falling through the funnel into the cyanide jar, which is then corked, and another one fastened to the funnel for the next tree. A similar apparatus is used abroad.

One can so arrange his route that the sugared trees are in a circle, and thus visit each regularly. It will be found that some moths come early and others only late at night. Frequently one can find some moths, like Catocalas, at the sugar next day. A few collectors have used baked apples to attract moths, and others string rotten apples dipped in sugar between trees.

Forceps or tweezers.—Small metal forceps (fig. 89) with fine points are used by nearly all entomologists in picking up insects. These are made both with curved and straight points, and can be purchased from dealers for a small amount. By practice with the forceps, one can handle the most delicate and fragile insects without injuring them. For handling the pinned specimens a stouter form of forceps, known as pinning forceps, is used. These are shown in figure 90. Most people become accustomed to a certain style and can use it better than any other; a lighter pair is preferred by many.

Brushes, belts, bags.—Several small brushes are useful to the entomologist. They may be used to clean an insect, and by moistening the tip to pick up small and delicate specimens. Many collectors who go into the field to gather insects of one group are often able to carry all their utensils (net, killing bottle, tubes, forceps, boxes, or folded papers) in the pockets of an ordinary coat. Others have coats especially made for the purpose of some very stout and durable material with deep pockets, so that in stooping nothing will fall out of them. Some carry a belt similar to a cartridge belt around the waist. Small pockets are sewed on to this to hold tubes or vials (fig. 91). Most entomologists, however, carry a haversack of waterproof cloth or leather, with several compartments to hold vials, empty boxes, killing bottles of several sizes, and a small box in which to pin delicate insects shortly after capture. This haversack or bag is slung across the shoulders by means of a strap.

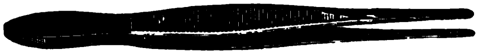

FIG. 89.—THE COLLECTING FORCEPS.

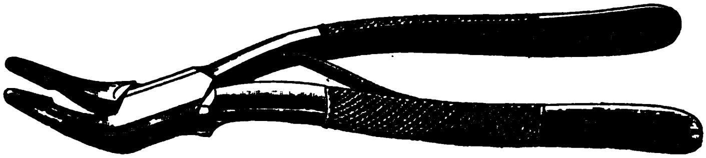

FIG. 90.—A PINNING FORCEPS.

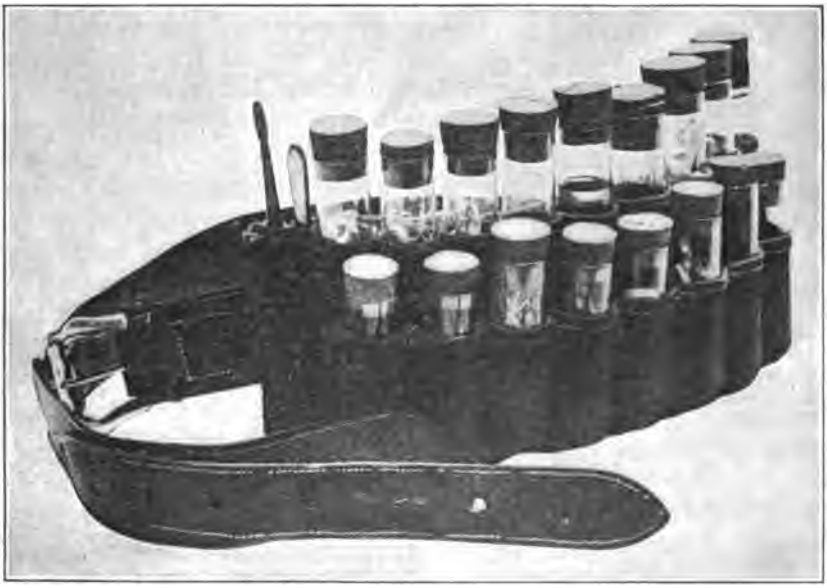

FIG. 91.—A BELT FOR VIALS.

The lens and microscope.—A hand lens or pocket magnifier is sold by all entomological dealers and by firms dealing in microscopic supplies. One should use some care in this matter, as a poor lens, especially if of high power, is apt to injure the eyesight. A half-inch lens will be found as useful as any for most insect work. For Lepidoptera a three-fourths or an inch lens will be useful. For the minute insects a one-fourth inch lens is used by many, but a compound microscope is better for the eyes.

An ordinary lens may sometimes be used to advantage in the field by fitting a piece of cork in the handle, and sticking an insect pin obliquely through it so that the point of the pin is at the focal distance of the lens. A strong reading glass is very useful in looking over boxes of specimens.

Dissecting microscopes sold by most dealers are of great value and should be more generally used. The compound microscope is necessary to all who endeavor to do some original work with small insects, or to study the anatomy of insects. There are various firms, a list of which is given in the back of this article, that supply these, as well as all accessories, slides, cover glasses, stains, etc. In these matters one must consult his means, but a useful instrument can be obtained for about $50. For studying the exterior structure of insects, it is not necessary to have much apparatus known as the substage, nor more than one or two eyepieces and objectives. Many microscopes are so fitted that one can revolve the mirror above the stage and reflect light from above upon the insect. For examining an insect it is well to fasten a cork to a glass slide and stick the pin in this cork. The cork may be fastened to the slide as follows: Drop a little Canada balsam on the slide, heat it to almost boiling from beneath, and then put the cork in it. When cold, the cork will be held firmly to the slide.

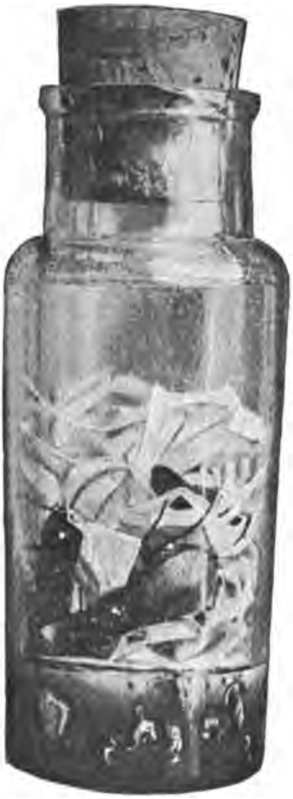

FIG. 92.—A CYANIDE BOTTLE WITH PAPER STRIPS TO GIVE SUPPORT TO THE INSECTS.

KILLING INSECTS.

A bottle or jar (fig. 92) containing a poison is used by all entomologists to kill their captures. The poison ordinarily used is potassium cyanide, a hard, white substance, which can be purchased at drug stores. There are various ways of preparing a bottle or vial. The usual way is to place the cyanide, broken up into a few lumps, in the bottom of the bottle, covering it with a little dry plaster of Paris; then mix some plaster of Paris with water, just sufficient so that it is about as thick as can be stirred; then pour it over the cyanide so as to cover it to a depth of about 5 mm. (one-fourth inch). The bottle is then left open for a couple of hours until the plaster is dry. After this the bottle should always be kept corked, so that the fumes of the cyanide are strong enough to kill the insects in a few moments. It is always well to place a few strips of blotting paper in the bottle to absorb any moisture and to prevent the insects from shaking against one another. A bottle well made should last several years.

Great care should be exercised in handling potassium cyanide, as it is a deadly poison, and if any is left over after one has prepared all the bottles desired it should be buried deeply in the ground. For small tubes a lump of cyanide may be wrapped in paper till it fits tightly in the bottom of the tube (fig. 93). Some prefer to fasten the paper containing the cyanide to the inside of the cork. In collecting a variety of insects one should have at hand a number of cyanide bottles, some large ones and others of a smaller size, so that the insects of each size may be kept together. Very delicate insects should be put in a cyanide bottle with a great deal of paper and no larger insects with them. Similarly, long-legged species should be kept by themselves.

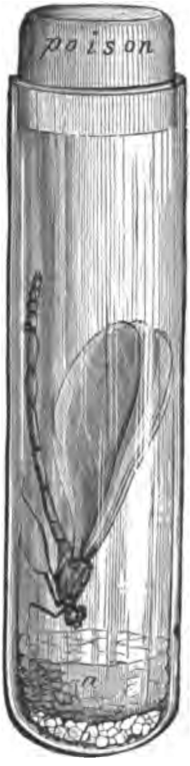

FIG. 93.—A POCKET CYANIDE TUBE.

Some claim that a few drops of tartaric acid added to the cyanide will make a stronger poison. In dry regions the cyanide does not act so quickly, and a few drops of water, or tartaric acid, or even soda water, will increase its effectiveness. Others put sawdust over the lumps of cyanide and then a layer of plaster of Paris. Mr. Ricksecker advises putting the cyanide into a short tube, closed up with blotting paper, and insert the tube tightly in a hole through the stopper or cork of the jar, the tube opening inside of the jar. By this method one can keep the jar clean, washing it out when desired, and one can recharge the tube easily, while the same stopper and charged tube can be used on other bottles of the same size. Mr. Wenzel has used small tubes open at each end, and charged in the middle with cyanide, for collecting minute insects.

Some entomologists for minute species, especially for securing insects from an umbrella, use a cork stopper through which is inserted a goose quill with the outer end cut obliquely (fig. 94). The minute insects may be scooped up with the end of the quill and fall through it into the bottle. If the cyanide jar is well made, most insects will die in a few moments. Those with bright yellow colors should not be left in any longer than necessary, as the cyanide vapor turns the yellow red.

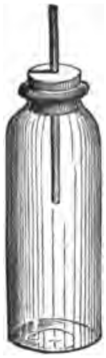
FIG. 94.—A BOTTLE WITH TUBE THROUGH THE STOPPER.

All delicate insects and those with fragile legs should be pinned as soon after their death as possible. Too much importance can not be placed on this matter, as delicate insects are rarely properly prepared, and the main difficulty is that they have been left too long in the poison bottle. Therefore, after one has collected a while, he should sit down in some shady nook and pin the more fragile species. Most insects, however, may remain in the bottle for four or five hours.

Various other poisons have been used to kill insects. English entomologists advocated the use of crushed laurel leaves. These, however, have not a very strong odor. Others prick the insect with a needle or pin dipped in a saturated solution of oxalic acid, after being quieted with chloroform. Many entomologists have used chloroform or ether to kill insects. Chloroform, however, is apt to stiffen the muscles of insects, so that it is not easy to spread their wings. When insects are collected in pill boxes, a drop of chloroform on the cover will soak through and kill the insect inside. Some take into the field a bottle of chloroform (fig. 95), with a brush attached to the stopper. Touching the side of the thorax of the insect with a moist brush will be sufficient to quiet it. Chloroform is so volatile that if enough is not used at first to kill the insect it will soon revive and damage itself in its struggles.

Chloroform may be used to advantage in collecting small insects that are very active in flight, particularly when they rest on the under surface of leaves. A wad of cotton is placed in the bottom of a tube, a few drops of chloroform poured upon it, and then a piece of blotting paper and some fine strips of loose paper placed over the cotton. The tube is brought stealthily up under the insect which, instantly overcome by the strong chloroform vapor, drops into the tube. Thus, one after another may be taken in rapid succession. Such tubes will last only a day or two. A piece of rubber soaked in chloroform will retain the odor for a long time. If the insects are to be pinned, it should be done shortly after they are dead, else they will be too stiff and dry.

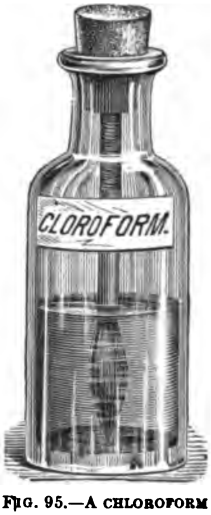

FIG. 95.—A CHLOROFORM BOTTLE WITH BRUSH.

Alcohol may be used to capture many wingless insects, such as springtails, myriapods, spiders, larvæ, etc., but adult insects should not be collected in it unless nothing better can be secured to kill them. Even for larvæ it is better to bring them home in tin boxes and kill and prepare them in other ways. Alcohol should not be used at full strength, but about 70 per cent is sufficient for most purposes. A little glycerin in the alcohol is an advantage, since if the bottle cracks, or the alcohol evaporates, the glycerin will keep the specimens moist for a long time. It is claimed by some that specimens killed in alcohol are less liable to verdigris, but the use of black pins obviates this danger.

Very large insects may be killed by injecting into their thorax a little kerosene; some have used benzine or gasoline to kill Lepidoptera in the field, squirting it upon the specimen by means of a druggist's dropping tube. Other collectors have used creosote for killing specimens. This, however, will not last more than a few days. Some entomologists have used ammonia for killing microlepidoptera, but it is liable to change some of the delicate colors. All things considered, the use of the cyanide jar is far superior to other methods.

PINNING INSECTS.

Entomologists mount their insects on pins especially made for the purpose. These are more slender and longer than the ordinary pin, and can be bought from all dealers in entomological supplies. As they are now comparatively cheap, all beginners should use them. The price averages about $1 a thousand; many are cheaper. They are made both bright and japanned or black. Some are of steel, and these are not as flexible but keep the point well.

These pins are made in different sizes or numbers, from 000, the most slender, up to No. 8, the thickest. The sizes below No. 1 are usually too small for satisfactory use, as they will not readily enter cork. They are useful, however, in making elbow pins, as explained later. Likewise the pins over No. 4 in size are too large for most insects, and should only be used for insects of extraordinary size. The best size for general use is a No. 2; for smaller insects a No. 1, and for larger, a No. 3. Many lepidopterists use a No. 3 for most specimens and No. 4 for larger forms. Some orthopterists use a No. 4 for most species. However, the No. 3 will carry well an insect of almost any size, and the use of larger pins is apt to result in destroying too much of the thorax. A No. 2 is best for beetles, Hymenoptera, Hemiptera, and flies; a No. 3 for the larger species, and a No. 1 for small forms. Many coleopterists, however, prefer to mount on points all beetles too small for a No. 2 pin.

Each entomologist has a different opinion as to the limits of use of each size, but the general tendency is that Nos. 1, 2, and 3 will cover almost all requirements except for minute insects. In length these pins vary from 34 mm. to 40 mm. The latter length is rarely recommended. Most collectors prefer a 34 mm. or 35 mm. (1⅜ inches) for all insects except Lepidoptera, Orthoptera, and Neuroptera, for which 37 mm. or 38 mm. (1½ inches) is recommended. Some Diptera (Asilidæ) and Hymenoptera (Ichneumonidæ) should have a 37 mm. pin.

It would be very advantageous if collectors generally would agree on certain lengths, as it would make our collections more uniform, especially where there is much exchanging of specimens.

These pins are mostly made in Germany, and are known as Klaeger, Karlsbader, Schleuter, etc., but several of the American dealers now make a pin of their own very similar to the foreign pins, and some claim of better quality. The black or japanned pins should be used for pinning most insects, while the bright or white pins may be used for points and all double mounts. The bright pins are apt to verdigris—that is, produce a green substance near the insect which will eventually rot the pin as well as mar the appearance of the insect. There are, however, a few groups of insects that do not verdigris, and for these bright pins are as good as black. Many aquatic insects and those whose larvæ feed in wood are more apt to verdigris than other forms.

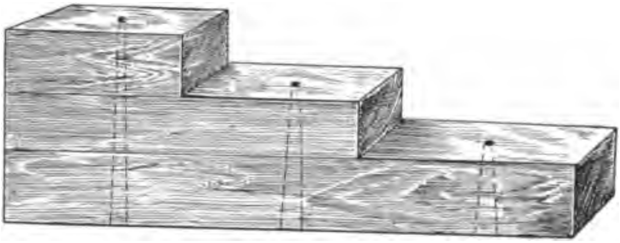

FIG. 96.—A PINNING BLOCK.

The English use shorter pins, but these are not in use now in the United States. Nickel pins are also obtainable from dealers. For small insects many entomologists use very short and slender pins, about 14 mm. long, without heads, known as "minutien nadeln," or "micro-pins." Sometimes fine silver wire is used for this purpose. It is handy to keep the pins in a pin tray or box.

Insects should be pinned as soon as possible after they are dead; the evening after collecting or the next day. Even specimens collected in alcohol should be attended to without unnecessary delay. Many fragile insects should be pinned in the field in a box taken along for that purpose. It looks better to have the insects all at the same height on the pins. For this purpose a pinning block is very useful. One can be made by examining the figure (fig. 96), three blocks with three holes, each going to the bottom. The upper hole can be used to fix the height of points, the next to fix height of label, and the third to fix height of specimen by inverting it and pushing the insect down to block. Fully one-fourth the length of the pin should extend above the insect (fig. 97). Some entomologists use brass blocks with a minute hole through them for the purpose of gauging the height of the specimen.

The insects should be dumped from the collecting jar upon some soft substance, as blotting paper, cloth, or a folded handkerchief. If soiled, they may be cleaned by a soft, dry brush; or, if beetles with earth attached, they may be washed in ether or benzine. With pinning, as other matters, practice makes perfect, and the beginner should use much care in learning to push the pin through the insect without injuring the parts, splitting elytra, or pushing out a leg. Beetles should be pinned through the right elytron (fig. 97), about one-fourth the distance from the base; most other insects, as Lepidoptera, Hymenoptera, Diptera, Orthoptera, and Neuroptera, through the middle of the mesothorax. In some groups, however, it is preferable to put the pin a little to the right of the center. The Hemiptera are commonly pinned through the scutellum. Many, however, are better pinned through the right wing near the base. The best way is to hold the specimen between the thumb and forefinger of the left hand and insert the pin with the right hand, so that the abdomen will be slightly depressed. Then the pinning block may be used to push the specimen up the pin, but the lapel of one's coat is about as handy as anything. Formerly many spread the legs of the insect. This is not considered advisable, but if they are folded up close they should be pulled out so that each part may be examined with a lens. The antennæ, if long, should be applied backward and near the insect, not sticking out at varying angles. When one captures a pair of insects in the act of mating it is useful to put them both on the same pin, the male above the female.

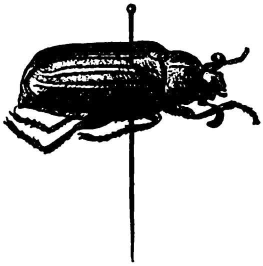
FIG. 97.—A BEETLE PINNED.

In mounting small insects the micro-pins are largely used, especially for Lepidoptera, Neuroptera, and Diptera, and even small Hemiptera. With Hymenoptera and Coleoptera they are not advisable. There are several ways of using these micro-pins in double mounts, as may be seen from the accompanying figure (fig. 98). The most popular way is figure 98, *b*, the micro-pin inserted in one end of a piece of cork and the ordinary pin stuck through the other end of the cork. These cork strips should be narrow, not longer than necessary, and are best cut with a razor. If the sheet of cork is covered with white paper, the strips make a neater appearance. Some have advocated the use of the pith of corn or yucca. The latter, if not well dried, will rot the pin, and with either material the micro-pin is not held as firmly as with cork. Some use blotting paper instead of cork strips, but this is apt to split. Others have recommended felt; a piece taken from an old felt hat, covered each side with white paper, and then cut into strips. Others have used strips from certain hard fungi.

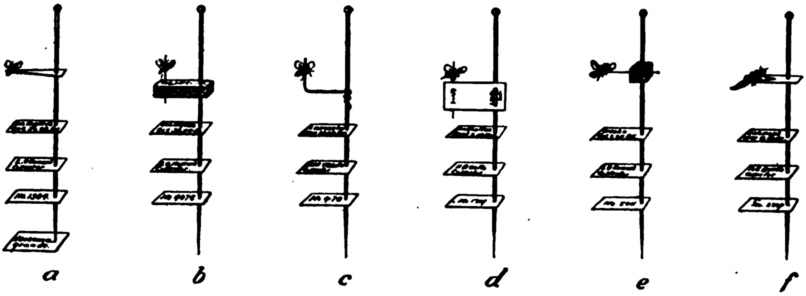

Fig. 98.—Micro-pin mounts, or double mounts: *a*, With a point; *b*, micro-pin in cork; *c*, elbow pin; *d*, micro-pin in paper; *e*, micro-pin in side; *f*, double point.

A neat way of preparing micro-Diptera as well as some other forms where one does not wish to mar the dorsum of the thorax is shown in figure 98,*e*. The micro-pin is pushed through a small square of cork, and then into the side of the insect, barely going through. A large pin is then inserted through the cork square. In figure 98,*d* is shown another method of using the micro-pin, with a strip of ordinary white paper, the pin inserted through opposite sides. Some use for certain insects bits of horse hair instead of micro-pins. One end of the hair is pushed into the side of the insect, and the other is inserted in a drop of shellac placed at the proper height on the pin. Another way of making double mounts is the use of an elbow pin as in figure 98,*c*. A fine pin has its larger end wound tightly a few times around an ordinary pin, and the tip bent upward enters the under side of the insect. The principal fault with this method is in getting the fine pin wound tightly enough to the other pin so that it will not turn nor slip down. Dealers sell machines for making these elbow pins.

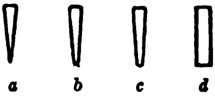

Fig. 99.—Points for mounting insects.

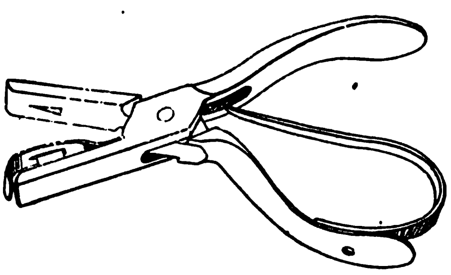

Fig. 100.—An insect punch for cutting triangles or points.

For many small insects, especially beetles, Hymenoptera, and Hemiptera, most entomologists use points—slender, triangular pieces of cardboard, as shown in the illustrations (figs. 98, *a*, 99). The dealers have punches (fig. 100) for making these triangles or points, but the points are usually much better when cut by the scissors Seven to 8 mm. is a standard length used by the majority of collectors. Different insects require a different width at tip, and this is readily gauged by one in cutting them with the shears. These points should be of very stiff paper, or a thin cardboard of such texture that they will not readily bend, yet not too stiff for a No. 2 pin. A bright pin, No. 2, 35 mm., is pushed through the broad end of the point, and the insect is fastened to the tip of the point by a little gum shellac, or gum tragacanth, or even a good quality of glue. The shellac should be dissolved in pure alcohol, and this requires some time. If there is much water in the alcohol the gum will not dissolve properly. Gum tragacanth is dissolved in water. A drop of corrosive sublimate or spirits of camphor added to the water will prevent the gum from souring. Mr. Dury recommends the following glue: One-quarter ounce gum arabic, one-eighth ounce gum tragacanth, dissolve in hot water, and to this add one-half teaspoonful of glycerine and 4 drops of carbolic acid. Shellac has an advantage over most glues in that it requires but a very small amount to hold an insect.

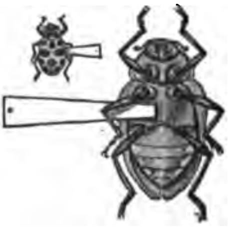
FIG. 101.—METHOD OF GLUING BEETLE ON PAPER POINT.

The insect should be mounted so that when the point is directed to the left the head of the insect is away from the person. The point should hardly be as high up on the pin as is a specimen. In the case of Coleoptera and many Hemiptera and Hymenoptera, the insect is mounted with its back uppermost, but with many Hymenoptera and with some flies the back should be outward. The shape of the insect will be the guide in this matter. For many Coleoptera it is well to depress the tip of the point slightly so that it will fit to the insect. The idea should be to obscure as little of the insect as possible. In figure 101 one sees how the point should attach to the insect and yet leave the insect readily observable from beneath. The beginner is apt to use too much glue or shellac, but by practice one can get expert in this matter and increase the neatness as well as the value of the collection.

When mounting up a large number of specimens, put shellac on a few points only at a time. It is handiest, at least with beetles, to lay the insects upon their backs, and then with the point dipped in shellac pick up the specimen; then, when upright, press on the specimen slightly to fasten it securely to the point. With insects having long legs one may pick them up by a fine forceps and place them on the point; then, by use of a lens, arrange them properly on the tip.

Some use a fine brush, moistened, for picking up the insect and transferring it to the point. However, with some insects one is apt to use too much moisture. In pinning small specimens with micropins it is useful to lay the specimen on a piece of velvet or a folded handkerchief. One can thus do the work under a lens. Some have advocated the mounting of duplicates on strips of cardboard, as in figure 102, and then pinning up these strips several on one pin. It is, however, hardly to be advised, as one is too apt to leave such specimens without further attention—an eyesore in a good collection.

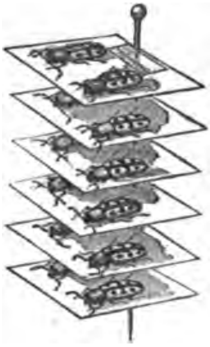
FIG. 102.—A METHOD OF MOUNTING DUPLICATES.

For especially long or slender insects a double-tipped point (fig. 98,*f*) is handy, the thorax of the insect resting on one tip and the abdomen resting on the other tip. It is well to cut the points in winter time and have them on hand for use when the collecting season opens in the spring. Leaves showing the work of insects should first be dried, and then a small square of cardboard pinned above and below them to hold the leaf in place.

The appendages of insects may be mounted on the following plan, proposed by Doctor Horn: A hole, round or square, is cut in a piece of bristol board. A cover glass is fastened to one side by a thin circle of shellac. Into this cell put the appendage and cover it with a drop of Canada balsam; then put on another cover glass. This preparation may be pinned, and placed in the collection by the side of the insect.

SPREADING INSECTS.

Such insects as butterflies and moths, dragonflies, etc., should have their wings spread out at right angles to the body (fig. 103). This is effected by the use of spreading boards (fig. 104), such as shown in the figure. Two strips of some soft wood, as linden, pine, or white wood, are fastened at the ends to braces, leaving a narrow groove between them. A strip of cork or pith is tacked or glued to the under side of the boards covering the groove. Many entomologists prefer to have the boards inclined slightly upward; others have them level. Some cover the boards with a thin strip of cork. Sometimes a board is fastened to the bottom of the braces and the cork attached to this; this gives more room for the legs of the insect.

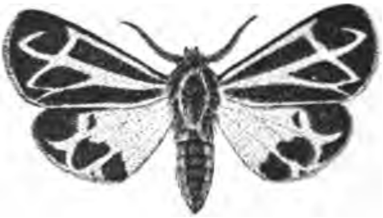
FIG. 103.—A MOTH, WITH WINGS SPREAD.

One should have several boards with different width of space, so as to admit insects of different sizes. The space should be just a little wider than the body of the insect. The wings should be carefully pulled forward and held down by a pin or spreading needle (fig. 106), and then covered with paper strips with a stout pin at each end (fig. 105). The specimens should be as uniform as possible, and the rule is that the hind borders of the front wings should form a straight line. This, however, is sometimes a trifle too much. Care should be taken that in pulling the wing forward one does not injure it. The pin or needle should be inserted just behind a strong vein near the base of the wing. Some utilize a spreading pin, which is made by twisting with the pliers a beheaded insect pin tightly around and near the point of a large mourning pin and forming a right angle to it. One can insert the mourning pin in the board behind the wings and the insect pin will hold the wings flat. The antennæ should be extended at or near the front margin of the wing, and the abdomen raised and supported, if necessary, by two pins placed crosswise beneath it.

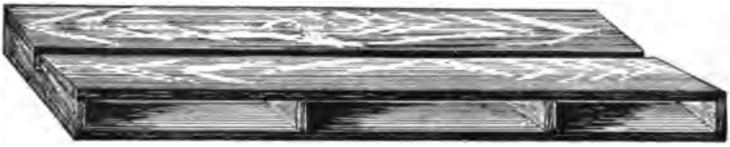

FIG. 104.—A SPREADING BOARD.

After one board is filled it should be put away in a box or case where it will be safe from dust until the specimens are thoroughly dry, when they may be removed and placed in the cabinet. A little naphthalene should be sprinkled in the drying box to prevent the incursion of Anthrenus. Some make an elaborate drying cage (fig. 108), with sides of fine wire screening and shelves or racks to hold the boards. If the insects are removed before they are thoroughly dry the wings will later spring back and droop down. Some entomologists bake the spread specimens, putting them in a slow oven for an hour or so, watching them carefully so they will not scorch. This enables one to dry them much more rapidly and thus handle a larger amount of material in a short time. Opinions differ as to the value of baked as contrasted with naturally dried specimens, and it is likely that climatic conditions have some effect.

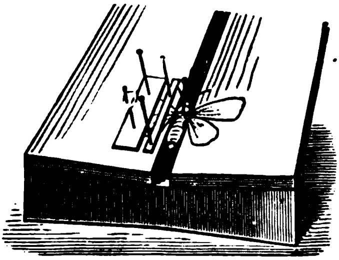

FIG. 105.—A SPREADING BOARD FOR LEPIDOPTERA.

Some use pieces of heavy glass instead of paper strips to hold the wings in place, but these are apt to slip and rub the wings. Frequently it is possible to fill the board with spread specimens, and then put two long strips of paper over the entire lot, pinning them down between the insects. Some entomologists have advocated the spreading of certain insects in an inverted position. Those which have the origin of the wings as high as the top of the thorax, as dragonflies, sawflies, etc., may be advantageously spread in this fashion. A long strip of cork or soft wood is fastened upon two or more low braces. Small holes are made here and there along the middle. The head of the pin is pushed through the hole till the back of the insect rests upon the cork or wood. The wings are then spread and fastened from beneath. By this method the legs are less liable to become broken than by the usual fashion.

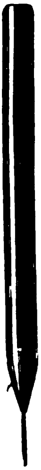

FIG. 106.—A NEEDLE FOR SPREADING INSECTS.

All Lepidoptera should be spread, although with a series of one species it is well to have one or two specimens with the wings in the natural resting position. Nearly all the Neuroptera, the stoneflies, the dragonflies, the caddiceflies, the Cicadas, many Fulgorids, most of the Orthoptera, and sawflies, should be spread before they are suitable for study or the cabinet. Most other insects are not spread, and for purposes of study are better so, since the spread wings are often in the way when one examines them by a hand lens. For a museum collection many of the flies and Hymenoptera look better if spread. With beetles and Heteroptera it would be well if one or two specimens of each species could be spread, since it is impossible to see the venation of the hind wings of these forms when mounted in the usual way, and specialists in these groups know little about these important structures. With many beetles it is not easy to spread the elytra out horizontally, but if they are raised and slightly divergent the under wings may be brought out and spread so that all parts may be examined with a lens. Frequently with Orthoptera and some other insects the wings of one side only are spread. This saves space in the cabinet and also shows how the insect holds its wings when at rest. It does not, however, look so well with Lepidoptera.

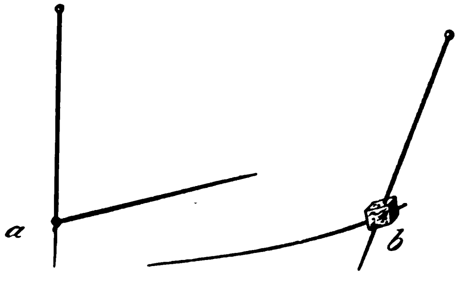

FIG. 107.—SPREADING PINS: a, FOR LARGE INSECTS; b, FOR MICROLEPIDOPTERA.

For Microlepidoptera, small moths, flies, and other tiny insects a modification of the spreading board has been devised, as shown in the illustration. It consists of a small block broader at base, with a groove along the top filled with pith, and deep enough for a micro-pin. Strips are fastened over each side, leaving a narrow groove between them. These blocks may be made solid and the groove may be cut triangularly, so that the bottom is a little wider than the top. Mr. Busck has devised a method of carrying these Micro spreading blocks in an insect box, as shown in figure 109, the box holding several rows of the blocks, and triangular strips of wood fitting down between the blocks to hold them in place. One may carry this box out on a long collecting trip and spread the captures as desired.

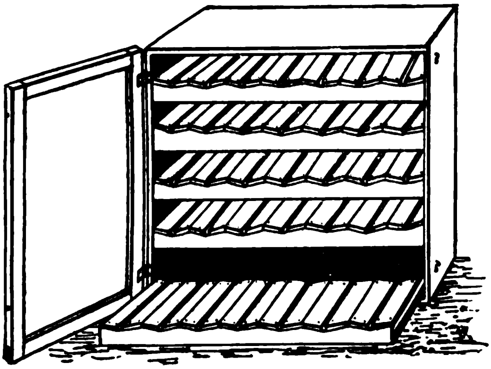
FIG. 108.—A DRYING CAGE.

Micros should be spread when fresh, if possible. If it is necessary to wait, then after the specimen has been pinned a slight puff blown against it from behind will diverge the wings and make more easy and successful the job of relaxing and future spreading. In the field it is often well to pin Micros in a tin box with a piece of moist cork.

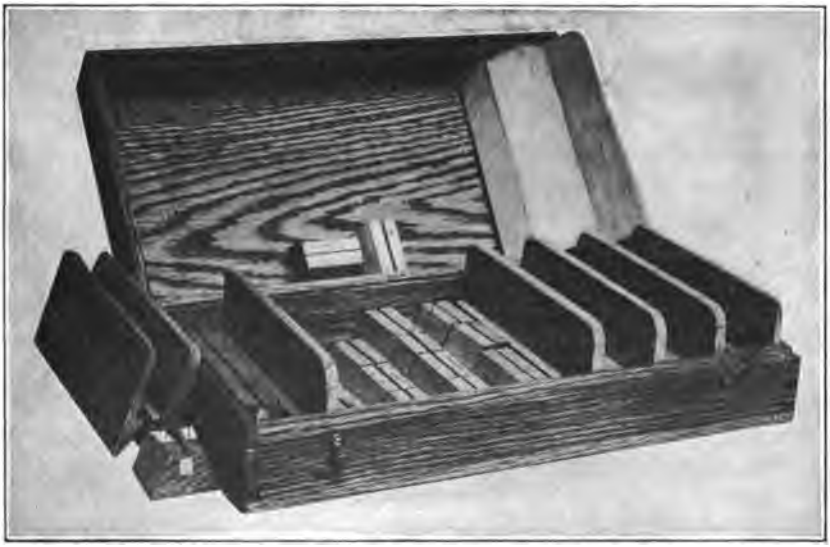
FIG. 109.—THE BUSCK BOX, FOR CARRYING SPREADING BLOCKS FOR MICROLEPIDOPTERA.

This keeps the specimen from drying out, as it is apt to do shortly after death.

In spreading the Microlepidoptera one must exercise great care and at first much patience. The upper side of the wing should not be touched with a pin. The wings may be brought forward into place by the instrument shown in figure 107. This is made by inserting a stiff bristle into a piece of cork and a pin nearly at right angles to it. Holding it by the head of the pin the point of the bristle may be passed under the wing, lifting it up and sliding it forward into place. A piece of paper is then pinned down over the wings, the forward pin being put in first. In putting down the strips of paper one must be careful to lay them right side up, for in cutting strips of paper one edge is always slightly turned, and if this edge is turned down on the wing it may scratch and rub the scales. The paper should entirely cover the wings, else the tips may turn up in drying.

Insects that are in papers or dry in the cabinet may be spread by softening or relaxing them. This is accomplished by placing them in a relaxing jar for a day or two. The relaxing jar is made of any tight metal box or earthenware jar, with an inch or so of moist sand in the bottom and a few drops of carbolic acid to prevent mold. One must not have the sand too moist, else the specimen will become wet. Some insects relax much more readily than others, so that it is well to have two or more jars. If there is much moisture in the sand it is better to put a piece of blotting paper over the top of the box or earthenware crock before replacing the lid. This prevents the drops of moisture which may accumulate on the lid from falling on the specimen. For relaxing a few small things one can put them in a saucer with some moist blotting paper, and cover them by an inverted saucer.

LABELING SPECIMENS.

After an insect has been pinned, or spread if necessary, the next step is to properly label it. The older entomologists had very general notions about this matter, and one is fortunate to find their specimens labeled with the State in which it was captured. But now it is considered necessary to have at least both the name of the town at or near which the species was taken, and the date of capture, upon a label pinned beneath the specimen. These locality labels (fig. 110) should be printed in small type, diamond preferred, on a good quality of paper, as linen ledger, and as shown in the illustration. Some entomologists prefer to have the state abbreviation at the right end of the label. Personally, however, I prefer to put it at the left hand. There should be no spacing between each label of one row, so that but one cut with the scissors will be necessary to separate them. The date can be written in the blank space as follows: 9 June 09, or

9–VI–09. It is not advisable to write 9–6–09, for one will get confused as to whether it is the 9th of June or the 6th of September. It is not advisable to have a label of more than two lines. Some entomologists, however, prefer to have the collector's name as the third line of the locality label.

The label should be pinned through the middle and a short distance below the specimen, so that it does not interfere with the legs. The label with most insects should extend lengthwise with the insect, but with those having the wings spread it is customary to have the label extend with the wings. For double mounts or for specimens glued on points, the label is commonly pinned through one end, so that its main length is on the same side of the pin as the point or piece of cork.

Below the locality label there are often other labels bearing the name of the collection or collector, a sex label, and labels indicating the circumstance of collecting. The latter, known as ecological labels, are increasingly popular, and should be used wherever possible. Insects, such as bees, etc., taken from flowers, should bear a label with the name of the flower; if taken at light, a label indicating that fact, etc. All phytophagous species should bear the name of the plant upon which captured. Some of these labels, which will be useful in particular cases, are as follows: At sugar, at light, electric light, twilight, sweeping herbage, from foliage, under bark, in moss, in meadow, in swamp, by stream, over pond, tree trunk, in fungi, sifting leaves, dead log, under stone, on ground, etc. Anyone can readily think of many other ecological labels which will be of value in his particular group. Many prefer to have these labels printed in two lines, as are those of locality and date. This may be accomplished by combining this label with that of the collector. The value and interest of a collection is vastly augmented by these ecological labels, and they are a good guide for finding other specimens of the same species. For sex labels the sign ♂ (Mars) is used for the male, and ♀ (Venus) for the female, and ☿ for the workers or neuters.

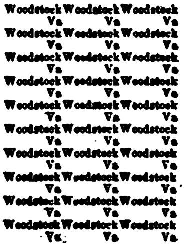
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FIG. 110.—LOCALITY LABELS.

By practice one can learn to write a fair hand in minute letters, so that written labels may take the place of the printed ones. In writing labels one should have especially fine pens, drawing pens, or crow quills, and use only india or waterproof ink. Good printed labels, however, can be bought for about 25 cents a thousand. Never put upon a pin a label so large that it requires to be folded, and always write labels in as small a hand as can be read without a lens. It looks badly in a collection to see unnecessarily large labels.

A method was devised by Mr. Hinds for photographing typewritten labels. He describes it as follows: "When a series of labels for a new locality, food plant, or collector is desired, the typewriter is used to write out in columns each desired label a proportionate number of times. A black ribbon is used, with clear white paper. If possible each column should be composed throughout its length of the same number of spaces, and a single space is sufficient to separate the columns. Attention to these points facilitates the cutting up of the labels. Prints are made upon a special portrait paper, and if the work of negative making and printing has been well done a very good, durable label may thus be obtained."

It is sometimes necessary with long words to abbreviate the name of the town. One should be very careful not to abbreviate more than absolutely necessary, and then in such a way that there can be no mistake about the name. For example, for New Rochelle, "New Roch." is better than "N. Rchll." It is better to have a long label than one which may be misunderstood. Some collectors like to have small printed labels with the specific name of the insect, sometimes abbreviated, pinned to each specimen near the end of the pin; it facilitates rearrangement and exchanging.

For keeping notes and records of specimens in a book, a number should be attached to the specimen corresponding to the number in the note book, but the locality label should never be omitted from these specimens. In some groups of insects it is necessary to use other labels. Insects reared from galls, for example, should have a number connecting them with the gall, and if any part of the insect has been removed to be mounted upon a slide for microscopic examination this fact should be noted on a label attached to the specimen.

Specimens placed in vials of alcohol should have the label, if not printed, written with waterproof ink on extra good quality of paper. The label should be allowed to dry thoroughly, and then placed into pure alcohol, or as pure as one can obtain, for half an hour or so; then it should be put within the vial, never pasted on the outside. If the label is long, it may be folded or formed to circle around the vial. These labels for alcoholic material need not be written as small as those for pinned specimens, but should be smaller than ordinary script. For labeling specimens on slides a square label of gummed paper should be used. These can be obtained in books from the dealers in microscope supplies.

In all matters of labeling one should give the information in as plain language and as brief a form as possible, and avoid all signs that can only be interpreted by reference to note books. Much information often put in a note book could be placed on a small label, and is thereby more certain to be always connected with the specimen. Bits of colored paper should never be used for labels. Where one has a considerable variety of labels it is handy to place each kind in an envelope and arrange the envelopes alphabetically in a small tray. Pencil labels that have been for years in alcohol sometimes become illegible. Mr. Henshaw has discovered that the writing can be brought out by gently washing the labels in yellow ammonium sulphide. This, however, will not permanently restore them.

In the matter of keeping notes collectors follow their personal idiosyncrasies to the limit, but some sort of a card system is considered best by practically all who have had much experience. In the making of notes follow Professor Comstock's advice, "Be sure you are right, and then look again."

STORAGE OF SPECIMENS.

A familiar method of collecting Lepidoptera and dragonflies is to put them in folded papers and store them in boxes until one has more leisure to mount and spread them. These papers are prepared as shown in the figure, the piece of paper being about one-half or one-third longer than wide. It is folded in the order of the numbering in the figure. After folding the papers they should be ironed so that the creases will stay put. These papers should be made of various sizes to accommodate the different sizes of insects. A number should be prepared in the winter time. This method of preparing insects is known as "papering" the specimens (fig. 111). The paper should not be too stiff nor glazed. Newspaper usually makes very good material, although some of these now are hardly good enough for this purpose.

After the specimens have been put in the paper with the wings folded over the back, one can write on the outside of the paper, beyond the edges of the insect, the locality and date. They should be stored in boxes. If the insects are perfectly dry, they may be kept in tin boxes, but tight wooden boxes are perhaps better, and in either case some flake naphthalene should be sprinkled over them. Insects thus prepared can be sent through the mails with safety. Some arrange these papered specimens in long card trays, with a card here and there to indicate the contents or localities.

Many of the minute Hymenoptera, Diptera, and Hemiptera may be stored in pill boxes nearly filled with torn bits of tissue paper. Beetles and Hemiptera may be packed in a small flat box between layers of velvet. Cotton should not be used, but when covered with soft paper will do for all except fragile insects. These methods of storing material are useful on extended collecting trips. Some collectors put up the larger insects, as Orthoptera, beetles, bees, etc., in tubes of paper. The insect while yet fresh is laid on a piece of soft paper, which is then rolled fairly tight around it and the ends tucked in. Others make tubes of various sizes by wrapping a piece of soft paper around a lead pencil or other cylindrical object, and turning in one end. Then put the insects in the tube and plug up the other end with cotton. All tubes and boxes of dried specimens should be packed in larger boxes with plenty of flake naphthalene.

In relaxing such specimens for pinning one should put the papers or tubes into a relaxing jar, and not attempt to remove the insect while dry from its cover. Collectors sometimes put up Coleoptera and Hemiptera in glass vials with clean sawdust, dampened with 9 parts alcohol and 1 part carbolic acid. A layer of sawdust is placed in the bottom, then a layer of insects, then a layer of sawdust, etc. It keeps them slightly moist so they can be easily pinned, but they require cleaning with a fine brush before they are suitable for the cabinet. Lepidoptera and Neuroptera should be put in papers; beetles, Hemiptera, and Orthoptera may be packed in boxes, tubes, or sawdust, or even in alcohol; Hymenoptera, and especially Diptera, should be pinned on all trips; in fact it is better to mount at least one or two specimens of the Coleoptera, Hemiptera, and Orthoptera.

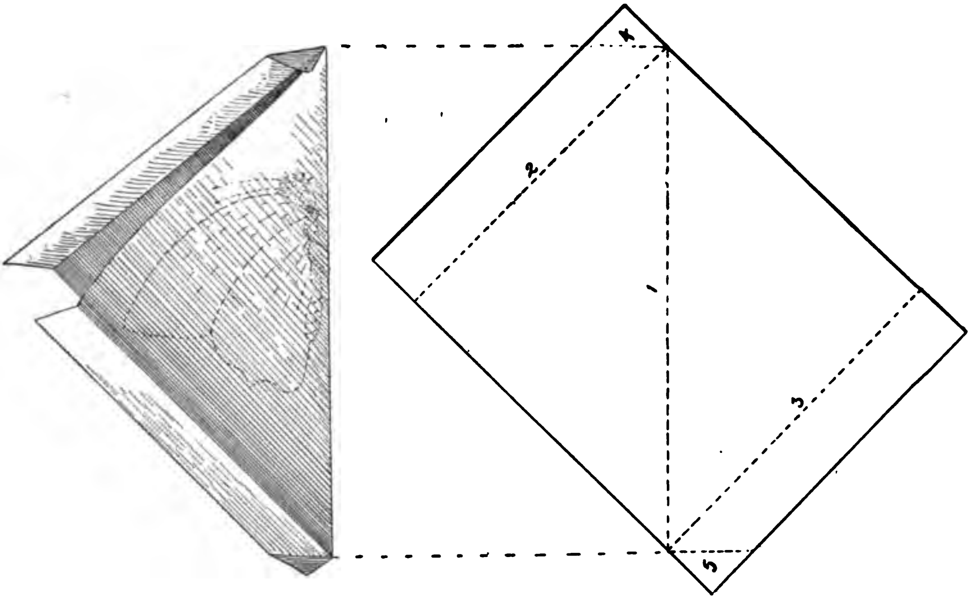

FIG. 111.—THE PAPER ENVELOPE FOR LEPIDOPTERA, AND METHOD OF FOLDING IT: 1, FIRST FOLD; 2, SECOND FOLD, ETC.

MOUNTING SPECIMENS ON SLIDES.

Many insects are so minute that they can not be pinned, and can only be studied by the aid of a microscope. These insects are preserved by mounting them in Canada balsam upon a piece of glass called a slide (fig. 112). These slides, 3 inches long and 1 inch wide, the Canada balsam in small tubes, and the cover glasses to place over the insects can be purchased from all dealers in microscope supplies. A drop of the Canada balsam is put on the center of the slide and the insect put in, its legs or wings arranged with pins, and then the cover glass put on and pressed slightly so that the balsam will spread out and fill all the space. Care should be taken not to use too much balsam, for the amount should be no thicker than the thickness of the mounted insect, else one can not use the higher powers of the microscope. Sometimes it is useful to heat the balsam after the cover glass has been put on. This is done by means of a small alcohol lamp, purchasable from the dealers. This heating induces the balsam to harden more quickly, but with many soft insects too much heating will break the skin or drive out the juices and discolor the mount.

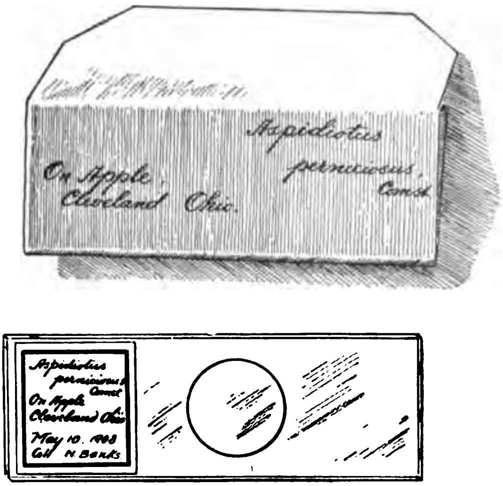

FIG. 112.—A BALSAM SLIDE MOUNT AND JACKET COVER FOR SAME.

There are other media than Canada balsam in which to mount specimens, and if any of these are used it is necessary to cover the edge of the cover glass with some material such as Brunswick black to prevent evaporation. It is not necessary to seal up balsam mounts. Insects for mounting are prepared in different ways. Sometimes it is better to kill them in hot water or in acetic acid. If the specimen has been in alcohol this should be removed by a bit of blotting paper, and the specimens placed in clove oil or xylol for a few minutes, heated slightly, and then mounted in the balsam. Different methods will be found to apply to different insects or their parts. After the mount has been prepared the slide should be labeled by attaching a square gummed label to one end of the slide. The slides should then be left flat until the balsam is dry, and afterwards may be arranged in a box or tray (fig. 113). Wooden boxes are commonly used, each having space for

25 slides. Others lay the slides on sliding shelves of a large box or case.

Mr. Marlatt has perfected a way of keeping slides on the card system which is superior to all other methods. Each slide is put in a small manila envelope or jacket (fig. 112), expressly made for this purpose, and these placed on edge as cards in a tray. The cabinet, holding several trays each, with three rows, is made by dealers in library supplies. On the outside of the envelope may be written the name and locality of the specimen or other information. Guide cards, with the name of the species or the genus, may be used to separate the series. By this method one may insert new slides or new species at any time in their proper places, and all are secure from dust. One must be careful that the balsam is fully dried before putting the slides in these jackets.

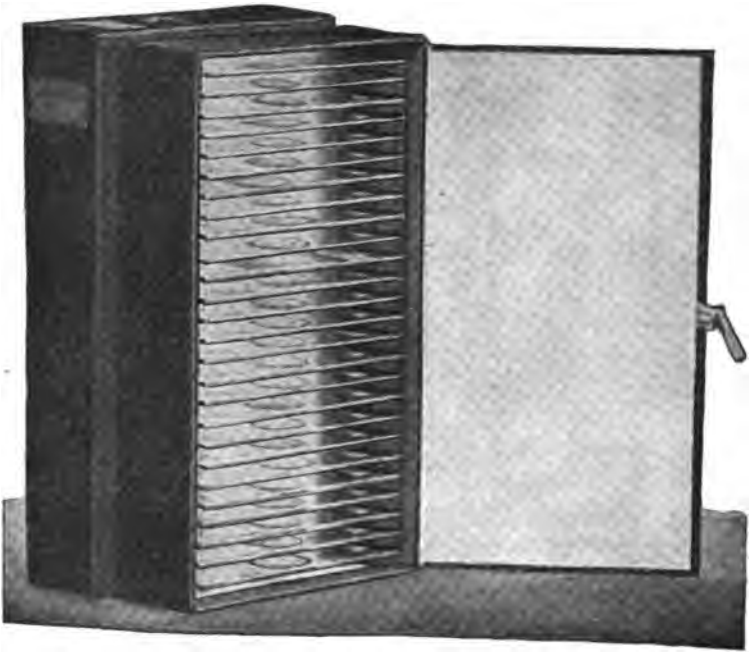

FIG. 113.—A CASE FOR STORING SPECIMENS MOUNTED ON MICROSCOPE SLIDES.

Most of the wingless insects are best studied when mounted on these slides, as also larval and immature stages of other insects, and the sections of mouth-parts, etc. For studying the general structure more elaborate methods are required, which may be learned from a number of books on microscopical and histological technique.

PREPARATION OF LARVÆ.

A method of preserving caterpillars by inflation has long been used by lepidopterists. The larvæ should be killed in a cyanide bottle or in alcohol. Cyanide is generally considered the best for most larvæ. The caterpillar is placed on a piece of blotting paper, a pencil is rolled over the larva from the head to the tip of the body, thus protruding the tip of the alimentary canal. This is snipped off by a pair of scissors or a sharp knife, and then by rolling a pencil, as before, a number of times over the larva the contents are squeezed out of its body. One should be careful to do it rather slowly, at least with delicate larvæ, so that the skin is not broken, for if rubbed too hard or too long the pigment may be removed from the skin. The caterpillar should be moved about on the blotting paper during the operation, so that it is not soiled by its own juices.

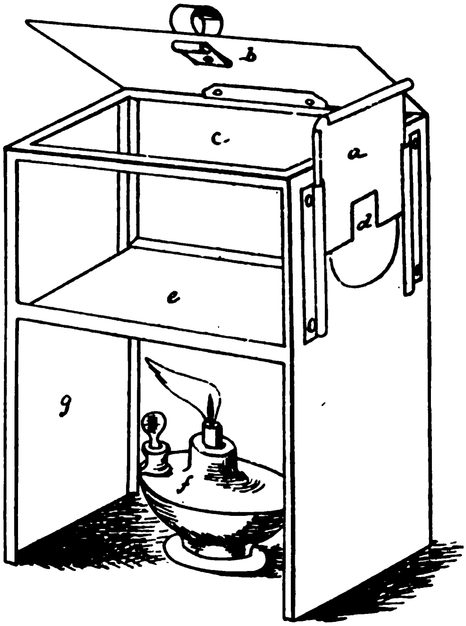

FIG. 114.—A DRYING OVEN FOR THE INFLATION OF LARVÆ.

A glass tube with its tip drawn out to a fine point is then inserted into the anal opening. The skin may be fastened on the slender point by a bit of thread or a drop of glue. If the glass tip fits rather tightly into the aperture, then the skin may be placed a moment in the oven and then withdrawn. This will stick the skin to the end of the glass. A spring or clasp of steel may be so arranged as to hold the larva to the tube, or the skin may be held to the glass tube by a common insect pin bent around the tube and then forward, with the tip recurved (fig. 115). One may inflate the skin by blowing in the tube; but a more effective way is to have a rubber tube on which is a large rubber pneumatic bag and a smaller inflating bag at the end. By squeezing the inflating bag the larger bag becomes inflated, and this makes a steady pressure upon the larval skin. This operation of inflating the larva should be performed over a small tin oven, as shown in figure 114. The glass tube with attached larva is inserted through the hole "*d.*" If one expects to inflate many larvæ, an apparatus of this sort will be very useful. But if only a few, or, for a beginner, a bottomless tin can, supported by a wire frame over a flame, is an effective substitute. Mr. Merrick has devised a very elaborate apparatus for inflating larvæ which is warranted not to injure the specimens and demands but little attention. It is figured in Entomological News, 1908, page 10.

The inflated specimen is pinned as follows: A piece of copper wire is twisted around the middle of a small cube of cork, which is pierced by a pin. Then the wire is bent to form an oval or diamond-shaped loop about one-sixth of an inch long and again twisted to the end. This twisted part is inserted into the larval skin or the larval skin mounted upon it from below by a little shellac. With practice one can become expert in inflating larvæ, so as to preserve the shape and natural colors. Instead of a fine-pointed glass tube some use a straw, but this is hardly as satisfactory a method. The blown larva may also be preserved by placing it in a glass tube and fastening this tube in the collection.

A great variety of larvæ may be inflated by this method, but the larvæ of Coleoptera, Diptera, and Hymenoptera keep very well in alcohol or some similar liquid. Some entomologists have recommended preparing the larvæ of Microlepidoptera without pressing out their contents. This is done by placing them in a tin box of sand and heating it with the flame from an alcohol lamp. The gas generated in the larva inflates it and keeps the skin stiff when dry. They may be gummed to cardboard points or mounted in the same way as other lepidopterous larvæ. Mr. Busck, however, prepares the larvæ of Microlepidoptera on the same plan as used for the Macros. The glass tubes have very fine points. The contents of the larva is rolled out as usual. The point of a glass tube is then inserted into the end of the larva and then for a moment put in the oven. This heating attaches the skin to the glass tubing. Then it is blown as usual by the rubber bulb. When dry, he does not attempt to remove the larva from the glass, but cuts the glass near the larva and mounts it by the use of a micro-pin touched with shellac and fastened through the tube into the larva, the other end in a small cork square mounted upon an ordinary insect pin. This work should be done as rapidly as possible, for the skin will dry if not blown at once after the removal of the contents.

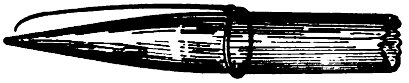

FIG. 115.—A CLIP FOR HOLDING CATERPILLARS.

PREPARING WINGS FOR STUDY.

It is very necessary in studying the venation of Lepidoptera to denude the wings or to bleach the scales. Removing the scales with a camel's-hair brush is the quickest method, but one is apt to injure the membrane. Most entomologists use some sort of bleaching process. Several of these are described below.

Doctor Dimmock used chlorine in the form of chloride of lime. The wings are first soaked in pure alcohol. The chloride of lime is dissolved in 10 parts of water and filtered. A little is poured into a shallow vessel. The wings are then transferred to this, and in an hour or two are thoroughly bleached. When sufficiently clear the wings are dipped into dilute hydrochloric acid, and then washed in pure water and mounted upon a slide in Canada balsam. Doctor Howard recommended the following process: The wing is removed and mounted upon a slide in plenty of Canada balsam. The slide is then heated over the flame of an alcohol lamp until the balsam spreads well over the wing. Just as it is about to enter the veins the slide is placed on ice, or, in winter time, outside of the window, for a few minutes. This hardens the balsam immediately and prevents it from entering the veins, which remain filled with air. With practice one can select just the proper time when to remove the slide from the flame and secure the best results. Doctor Smith recommends the following method: He puts the wings in a mixture of chlorine and hydrochloric acid. This decolorizes the wings at once, and they may be mounted within a few minutes. The advantage is in the rapid work. The disadvantage is in the vile odor of the chlorine gas which is liberated by the mixing of the two liquids. Doctor Calvert places the wings in a caustic potash solution for twenty-four hours; then washes in water fifteen minutes; then in a watery solution of Bordeaux red for twenty-four hours; then washes in water and floats on cards to dry.

Mr. Tower recommends bleaching wings as follows: Place the wing in a crucible partly filled with hydrogen peroxide and cover it. Boil until the scales are bleached. Wash in water for fifteen minutes; then in 70 per cent alcohol for a like time. Stain from one to three hours with cyanin, gentian violet, or rosaniline. Remove from stain and wash for fifteen minutes in 50 per cent alcohol, and for thirty minutes in water. It may be necessary to repeat this washing if the stain is not removed from the membrane. Then mount in glycerine jelly. For balsam mounts, bleach as above; then wash in water, and in 50 per cent alcohol each for fifteen minutes; then remove and stain in cyanin for two hours; then wash in 50 per cent, 70 per cent, and 90 per cent alcohol, ten minutes in each. Remove the surplus stain and air bubbles by thoroughly washing; clear in oil of cloves;

and mount in xylol balsam. Wings treated by this method may be successfully photographed. Mr. Hall, in Entomological News, 1902, describes his methods of bleaching and photographing the wings as follows: "The wings are first moistened with alcohol, and then put in eau de javelle solution until thoroughly bleached. They are then removed to fresh water for five or ten minutes to remove the lime solution, thus preventing deposits in drying. Remove the wings by immersing a piece of paper in the water and floating the wing upon it, much in the manner of mounting seaweeds. The paper and wings are then removed together, and the surplus moisture removed with blotting paper. Lay a clean piece of paper over the wing, and place between the leaves of a book and dry under pressure. When dry the wings separate easily from the paper, and may be fastened to a sheet of glass with an atom of shellac. Place the sheet of glass in an ordinary photographic printing frame with a sheet of sensitive paper, and place in the sun until the paper turns dark and bronzy. On removing the paper the outline and veins of the wings are seen in exquisite detail in white against a dark ground." The wings of other insects can be used without preparation. Velox or any of the developing papers may be used, and then the work can be done in the evening.

Mr. Busck, for the Microlepidoptera, uses a very neat and successful method. The wing is carefully broken from the body, and then placed in a shallow dish of alcohol. Then it is floated out on a glass slide, and by the use of a fine badger-hair brush under a lens he removes the scales, occasionally dipping it in the alcohol to wash off the loosened scales. When clean it is floated on the center of the slide, and when about dry is covered with a three-fourths inch cover-glass. A slide label 1 inch square, with a circular hole one-half inch in diameter, is pasted down over the cover-glass, thus securing it to the slide. This one-half inch hole could be cut by a punch, but Mr. Busck moistens a one-half inch cover-glass, sticks it to the gummed side of the label, and then after pressing it down cuts it from above by a pin point or the tip of a sharp knife blade.

PRESERVATION OF MATERIAL IN LIQUIDS.

Alcohol.—Alcohol is the most useful and convenient liquid for preserving the immature stages of many insects, and for spiders, mites, centipedes, etc. Moreover, it is of increasing use in the preservation of much other material. Many of the Neuropteroid insects, such as mayflies, Perlidæ, Psocidæ, are well kept in vials of alcohol. And many Orthoptera, as cockroaches and earwigs, and some Neuroptera, as dragonflies and scorpion flies; some Diptera, as crane-flies, and a great many Hemiptera and Coleoptera are as well preserved in alcohol as when dry, and, whenever one has an abundance of specimens, it is well to put up some in tubes or vials of alcohol. Specimens so preserved are better suited for dissection or morphological studies than dry insects.

The best kind of vial in which to keep alcoholic material is a flat bottom necked vial like the ordinary homeopathic or "homo" vials sold by all druggists. The kind kept in stock by drug stores is frequently of poor quality, but they can order a better quality of heavier glass if asked, or these can be purchased from dealers in entomological and microscope supplies. It is best to have vials of but two or three sizes, 1, 2, and 4 dram, and for a collection of one group of insects one size will usually be sufficient. Many prefer to use straight tubes instead of necked vials. These can be obtained from the dealers. Professor Comstock has devised a square bent necked bottle which enables one to put the specimen in the box with the pinned insects; but it is better to keep alcoholic material in a separate collection. Professor Riley also devised a method for keeping vials in the collections, the bottle resting upon a block. This method has been shown to be far inferior to keeping specimens in the ordinary upright bottles. Others put a pin through the stopper of the vial and pin the bottle at a slight angle in the collection. But, as before stated, it is far better to keep alcoholic material by itself than mixed with the pinned specimens.

Cork stoppers, if of good quality, are superior to any other kind, but the difficulty is in obtaining good cork. The extra expense of the best quality of cork will be repaid by the better results. As one goes over his collection from time to time those stoppers that are poor can be replaced by new ones. The trouble in getting good cork stoppers has led many to the use of rubber. The great majority of rubber stoppers that are placed on the market are of poor quality and form crystals of sulphur which fall upon the specimens. This tendency may be reduced, it is claimed, by soaking the stoppers for an hour or so in hot water. To insert a rubber stopper in a vial one should put beside it a slender insect pin. This enables the compressed air to escape; when the stopper is fully in, the pin is withdrawn.

The percentage of alcohol to be used varies with the group of insects. If the insects have a hard body, 90 to 95 per cent will not injure them, but for most soft-bodied forms, as larvæ and spiders, 70 to 80 per cent is better. A good plan is to put the specimens first in a weak solution, 60 to 70 per cent, and then later in a stronger liquid. For many larvæ it is well to dip them into boiling water, or just bring them to a boil in water, before placing them in alcohol. One of the disadvantages of alcohol is its rapid evaporation. If the cork is poor or the vial cracks, the specimens are soon dried and may be ruined. To obviate this one can mix with the alcohol a little glycerine, about 1 or 2 per cent, or even less. Then if the alcohol evaporates the glycerine will keep the specimens moist for a long while. Specimens that have been dried can often be softened by soaking in warm water, and dipping in hot water, before putting them back in alcohol.

Other liquids.—Various other liquids have been tried as substitutes for alcohol. Formalin is the best as far as results are concerned. In fact, many larvæ preserved in a mixture of 1 part commercial formalin and 10 parts water (a 4 per cent solution), or even in a weaker solution, will keep as well or even better than in alcohol. The vapor from a dish of formalin will injure one's eyes, and when on the fingers it hardens the skin, so that it is not popular with those who wish to study their preserved material. For museum purposes, where specimens are rarely examined, it may find a place. It should be noted, however, that it will corrode zinc, and some styles of jars have zinc tops. Glycerin tends to darken specimens, so should not be used except in small quantities mixed with other liquids. Mr. Barber has tried various combinations of alcohol, formalin, glycerin, and carbolic acid, but found none that would preserve better than formalin. The mixture of alcohol and formalin usually produces a black precipitate, while the addition of glycerin darkened the specimens. A liquid known as synthol has been put on the market, but has no advantages over alcohol, except perhaps in price.

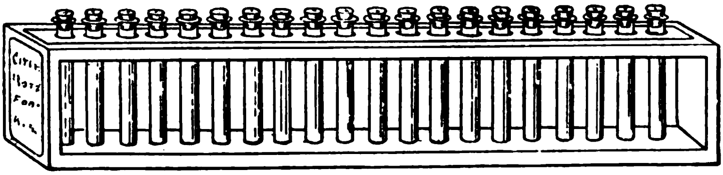
FIG. 116.—THE MARX TRAY FOR SPECIMENS IN ALCOHOL.

Storing alcoholics.—There are many ways of storing vials of alcoholic material. A cheap way is to take an empty cigar box and divide it into small squares by cross strips of stiff paper or cardboard, on the style of egg boxes. An ordinary box will hold about 60 or 66 2-dram vials. A much better way is the use of slender trays, often called Marx trays, as shown in the illustration (fig. 116). This has a cork top with holes punched in it for the vials. A more economical plan is to discard the cork top and make the tray wide enough for two rows of vials (fig. 117). Then put a cardboard strip down the middle, with side partitions for each vial. Where one does not expect to examine specimens very often, the vials may be canned in a larger glass jar. For the beginner the ordinary pint Mason fruit jar will do, putting into it two tiers of vials, and then filling up with alcohol. This method is very useful for museums, where many specimens are rarely examined and there is usually insufficient help. A better quality of jar is then recommended, and several kinds are sold by dealers, none of which is as perfect as it should be for storage purposes. For exhibit purposes it is sometimes handy to nearly fill the vial with cotton, which, pressing the specimen slightly against the sides, holds it in place. If the specimen is of a pale color, a piece of dark paper may be put behind it. All collections of alcoholics should be examined twice a year, replacing alcohol and poor stoppers.

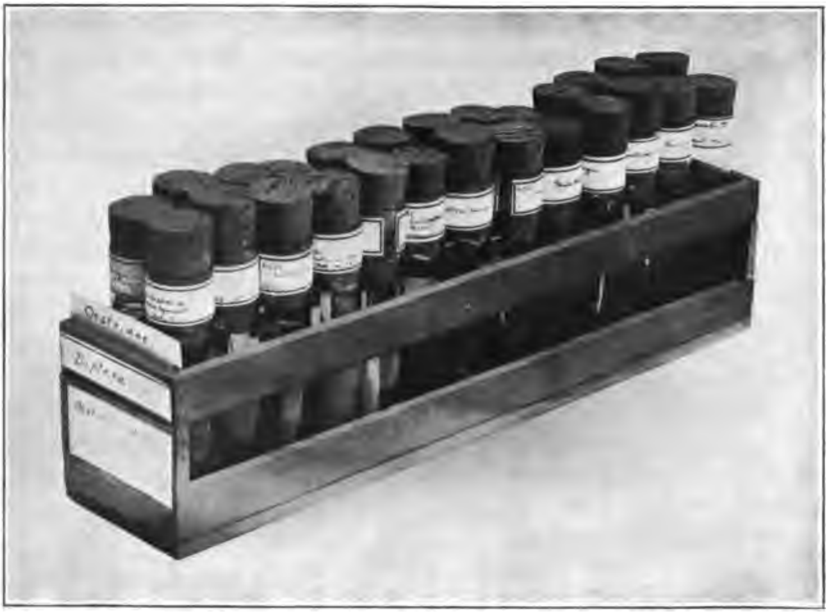

FIG. 117.—THE DOUBLE MARX TRAY FOR SPECIMENS IN ALCOHOL.

SPECIAL DIRECTIONS.

COLEOPTERA.

Beetles are more abundant than insects of any other order. As they have a hard outer skeleton, they are readily handled, and as it is not necessary to spread their wings, they are preserved with less trouble than most other insects. Although most abundant in the Tropics, several large families prefer temperate or even cold climates, and are found as far north as any other insects.

Few persons have had a more extended experience in collecting Coleoptera than Mr. E. A. Schwarz, and the following account has been prepared by him and is given in full:

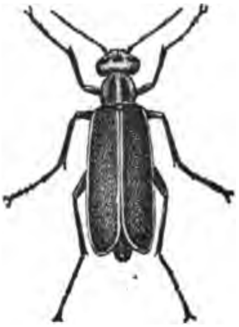

FIG. 118.—A MELOID BEETLE, EPICAUTA MARGINATA.

WINTER COLLECTING.—There are more species of Coleoptera hibernating in the imago state[a] than in any other order, and winter collecting is therefore most profitable in many respects. For instance, great swampy tracts which are inaccessible in the summer season harbor an abundance of rare Coleoptera, which either can not be found in summer time or are found at that season with the greatest difficulty. At the approach of winter, however, all or most of these species will leave the swamp and seek drier ground, where they hibernate under old leaves, under bark of trees, or in rotten stumps near the edge of the swamp. Such places will, therefore, give a rich harvest to the coleopterist late in the fall, during warm spells in midwinter, and in very early spring. If the temperature is below the freezing point, or if the ground is frozen hard, no winter collecting should be attempted, first, on account of sanitary considerations, and also because the Coleoptera then retreat more deeply into the ground and can not be found so easily as when the ground is free from frost. Other good collecting places in winter are the accumulated old leaves along the edges of forests or under the shrubbery along water courses, thick layers of moss, and the loose bark of dead or dying trees, and, finally, also under the bark of certain living trees, e. g., pines, sycamore, shellbark hickory. Digging in the ground at the base of large trees or rocks also yields good returns. The only instruments necessary for winter collecting are the sieve, the chisel, and the trowel.

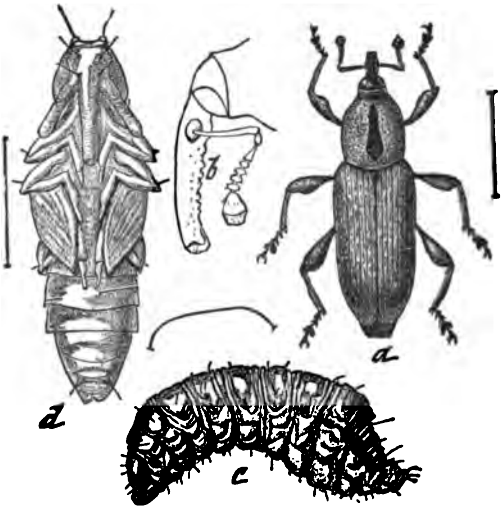

FIG. 119.—A WEEVIL, SPHENOPHORUS OBSCURUS: *a*, BEETLE; *b*, HEAD; *c*, LARVA; *d*, PUPA.

SPRING COLLECTING.—With the first days of spring, collecting becomes a little more varied. The methods used for winter collecting can still be continued with good success. Certain spring flowers, notably willow blossoms, will furnish many valuable species, which are not seen again during the rest of the season.

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[a] There are a few species of Coleoptera known in Europe which belong to the true "winter insects," i. e., such as appear in the imago state only during winter time, but whether or not we have such species in our own fauna has not yet been ascertained.

Myrmecophilous and Termitophilous species.—The early spring is also the best time for collecting the Myrmecophilous and Termitophilous Coleoptera. Termitophilous species have in North America hitherto been found only in connection with the white ants (*Termes flavipes*), and the inquilinous beetles are found running among the white ants in the colonies under stones, loose bark of trees, and more numerously in the interior of old infested trees. Myrmecophilous Coleoptera are by far more numerous in species than the Termitophilous species and are found among many species of ants which have their nests either under stones or loose bark of trees, in stumps or logs, or which construct larger or smaller hills. Upon uncovering a colony of ants under a stone, the underside of the latter as well as the galleries of the ants in the ground should be carefully examined for inquilines, which from their greater or slighter resemblance to the ants are liable to be overlooked by an inexperienced collector. If such colony of ants harbors a rare beetle the subterranean part of the colony itself should be dug out and sifted, but since from the stony nature of the ground this is not always practicable it is to be recommended to carefully replace the stone under which the colony has been found. Upon revisiting the spot again the next day or even a few hours after the first visit additional specimens of the inquilines are usually to be obtained on the stone or in the superficial galleries of the ants. Ant colonies in hollow trees and in rotten logs should be sifted and there is no particular difficulty connected with this operation. Owing to the pugnacious character of the hill-constructing ants it would seem to be a rather unpleasant task to examine a strong and vigorous colony for inquilinous beetles, but the collector must not mind being bitten and stung by the infuriated ants, and after a little experience he will find that it is not such a difficult thing after all to attack even the largest ant-hill. The only thorough way of investigating such ant-hills is to sieve the same, which can be easily done if the hill is composed of sticks and other vegetable débris. If it is built of earth or sand the process of sifting is more difficult and tedious. Another method of securing specimens of these inquilinous beetles is to place flat stones or similar objects on the surface of the ant-hill and to examine them occasionally, when the beetles will be found on the underside of the traps.

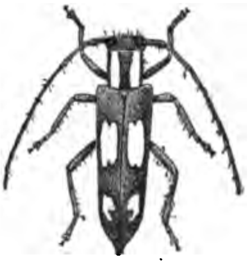

FIG. 120.—A LONGICORN BEETLE, SAPERDA CRETATA.

Spring flights of Coleoptera.—On the first really warm days of spring commences the "swarming" season of Coleoptera, when all winged species are flying about, especially toward evening. On favorable days the number of specimens and species that can thus be found is astonishingly great, and this is one of the few occasions when the coleopterist can advantageously use a light butterfly net. The flying beetles preferably alight and rest on the top of wooden fences (especially newly made ones), on the railings of bridges, etc., where they can be easily seen and secured, or they are attracted in great numbers by the white-painted surface of buildings. This flying season lasts in the latitude of Washington from the end of April to the middle of June, but favorable days are not of frequent occurrence, since a peculiar combination of atmospheric conditions appears to be necessary to induce the Coleoptera to fly about in great numbers.

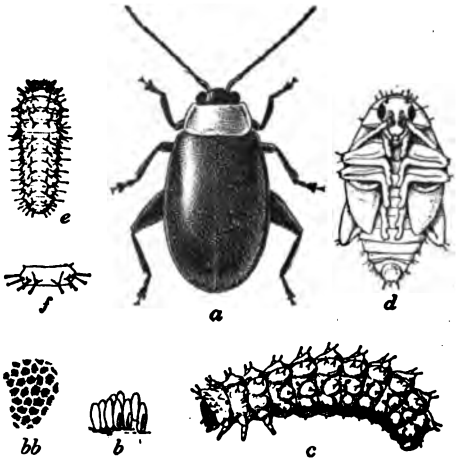

FIG. 121.—A CHRYSOMELID BEETLE, DISONYCHA XANTHOMELÆNA: *a*, BEETLE; *b*, EGGS; *bb*, SCULPTURE OF SAME, HIGHLY MAGNIFIED; *c*, LARVA; *d*, PUPA; *e*, NEWLY HATCHED LARVA; *f*, SEGMENT OF SAME.

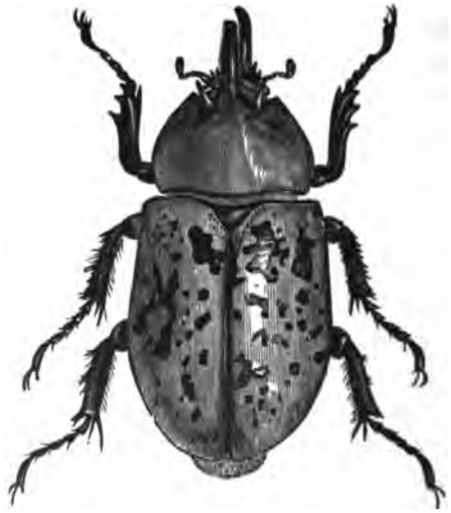

FIG. 122.—THE RHINOCEROS BEETLE, DYNASTES TITYUS.

Beach collecting.—Along the shores of the ocean and the Great Lakes untold numbers of Coleoptera and other insects fall at this season into the water, and, if the tides, the currents, and the winds be favorable, they are washed ashore by the waves on the sandy beaches, where they often form windrows several inches in height and width. If the collector is happy enough to be at the right place on the right day he has then the opportunity to pick up hundreds of rare species within a very short time and without any trouble. Many of the specimens thus washed ashore are dead and decayed, but the majority are alive and in excellent condition. This "beach collecting" affords also an excellent opportunity for the hymenopterist and hemipterist to secure large numbers of rare species, but favorable days are also here of rare occurrence.

Attracting by lights.—On the beaches, day and night flying insects can thus be captured. Away from the beach night-flying Coleoptera can best be collected at the electric lights of our cities; but, as in the Lepidoptera, not all night-flying species are attracted by the light. Gas and other lights also attract Coleoptera, and the various "light traps" that have been devised and described can advantageously be used for collecting these insects.

Traps.—The method of "sugaring," so important to the lepidopterist, is by far less favorable for collecting Coleoptera. Still, certain rare Carabidæ, Elateridæ, and Cerambycidæ are attracted by this bait, and the coleopterist should not entirely ignore this mode of collecting. There are a few other methods of trapping certain coleoptera. By laying out dead mammals, birds, fishes, snakes, etc., on suitable places and so that they are protected from dogs, rats, etc., the carrion-feeding Coleoptera can be found in great abundance, but a cleaner and less disagreeable method of obtaining them is to bury in the ground tin cans or glass jars so that the top is even with the surrounding ground and to bait them with pieces of meat, fried fish, boiled eggs, etc. Many Curculionidæ, Scolytidæ, and numerous other wood-inhabiting species can be successfully trapped in the following way: A number of branches, preferably of only one kind of tree, are cut and tied up into bundles of convenient size. The bundles are then laid on the ground in a shady place or firmly fastened on trunks of trees. When the cut branches begin to get dry they will attract many of these Coleoptera, which can then be readily collected by shaking the bundles out over the collecting cloth.

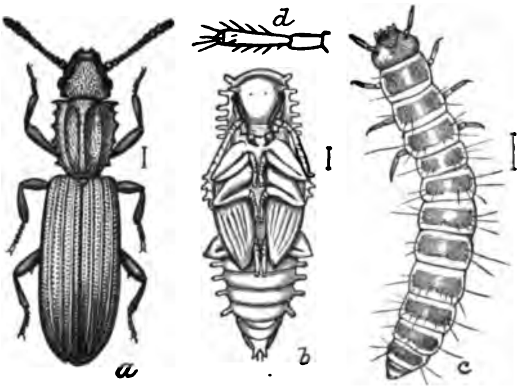

FIG. 123.—A CLAVICORN BEETLE, SILVANUS SURINAMENSIS: *a*, BEETLE; *b*, PUPA; *c*, LARVA; *d*, ANTENNA OF SAME.

Freshets.—Freshets usually take place in springtime in most of our rivers and creeks, and furnish the means of obtaining a multitude of Coleoptera, among which there will be many species which can not, or only accidentally, be found otherwise. These freshets, sweeping over the low banks or inundating wide stretches of low land, carry with them all insects that have been caught by the inundation. Intermingled with, and usually clinging to, the various floating débris, these insects are eventually washed ashore by the current at various points and the coleopterist should not miss this rare opportunity, but go out to the river bank at a time when the water is still rising, or at least when it has attained its highest point. Among, or on the washed up débris, a multitude of Coleoptera of various families can be found, and the specimens can either be gathered up on the spot or a quantity of the débris be put in sacks and taken home, where it can be examined more thoroughly and with greater leisure than out of doors. A day or so after the floods have receded the washed up specimens will have dispersed and only a few will remain in the débris for a longer period. Still more profitable than the spring floods are the summer freshets, because a larger and more diversified lot of Coleoptera is then brought down by the water. A similar opportunity for collecting is offered near the seashore if unusually high tides inundate the low marshes along the bayous and inlets.

FIG. 124.—A CHRYSOMELID BEETLE, OCTOTOMA PLICATULA.

SUMMER COLLECTING.—During the latter part of spring and throughout the whole summer, when the vegetation is fully developed, every possible collecting method can be carried on with success, so that the beginner hardly knows what particular method to use. There are stones to be turned over; old logs, stumps, and hollow trees to be investigated; newly felled or wounded trees to be carefully inspected; here a spot favorable for sifting claims attention; promising meadows and low herbage in the woods invite the use of the sweeping net; living or dead branches of all sorts of trees and shrubs to be worked with the umbrella; the mud or gravel banks of ponds, lakes, rivers, and creeks afford excellent collecting places; the numerous aquatic beetles are to be collected in the water itself; the dung beetles to be extracted from their unsavory habitations; in the evening the electric and other lights are to be visited, the lightning beetles chased on meadows and in the woods, or the wingless but luminous females of some species of this family to be looked for on the ground, and the trees and shrubs are to be beaten after dark in search of May-beetles and other nocturnal leaf-feeding species which can not be obtained at daytime; and, finally, some of the rarest Scarabæidæ and some other species fly only late at night or again only before sunrise.

In view of this embarrassing multitude of collecting opportunities in a good locality, the beginner is apt to be at a loss what course to pursue. Experience alone can teach here, and only an expert collector is able to decide, at a glance at the locality before him, what collecting method is likely to produce the best results, and his judgment will rarely be at fault.

It is impossible to go into details regarding the various collecting methods, just mentioned, and only a few general directions can be given regarding those methods which have not previously been alluded to.

Collecting under stones.—Turning over stones is a favorite method among beginners and yields chiefly Carabidæ, the larger Staphylinidæ, certain Curculionidæ, and a multitude of species of other families. Stones on very dry ground are productive only early in spring or in the fall, while those on moist ground, in the shade of woods, are good at all seasons. In the Alpine regions of our mountainous districts, especially above the timber line, collecting under stones becomes the most important method, and is especially favorable along the edges of snow fields. In often frequented localities the collector should carefully replace the stones, especially those under which he has found rare specimens. The neglect of this rule is one of the principal causes for certain rare species having become extinct in the vicinity of our cities.

Collecting in rotten stumps and logs.—Success in collecting in rotten stumps depends much upon the more or less advanced stage of decay as well as upon the situation of the log and upon the particular kind of wood. If the decay is very much advanced, neither the loose bark nor the interior of the log will harbor many Coleoptera excepting a multitude of *Passalus cornutus* and its larvæ. If the decay is less advanced, but if such log is exposed to the scorching rays of the sun, it will be far less productive than a log in a shady situation. The investigation of the bark of a favorably situated log in the right stage of decay does not need any special instruction, but the decayed wood itself should be pried off with a chisel or trowel, put in the sieve and sifted on the collecting cloth. This is the best way of obtaining the numerous species of rare Micro-Coleoptera of various families that inhabit such places. A "red rotten" oak or beech log is more favorable for this mode of collecting than a "white rotten" of the same or other kinds of trees.

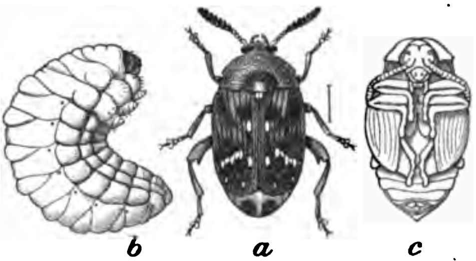

FIG. 125.—THE PEA WEEVIL, BRUCHUS PISORUM: a, BEETLE; b, LARVA; c, PUPA.

Collecting in dying or dead trees.—Dying or dead trees almost always harbor a large number of Coleoptera and offer an excellent collecting opportunity until the wood becomes thoroughly dry, which usually takes place in large trees two or three years after the death of the tree, and in less time with smaller ones. The bark of such trees is the best collecting place for Cucujidæ, Colydiidæ, Scolytidæ, Histeridæ, etc., and it will be found that the shady side of the tree is more profitable than the side exposed to the sun. The numerous Buprestidæ, Elateridæ, Ptinidæ, Cerambycidæ, Melandryidæ, etc., which breed in the wood can be obtained only with difficulty. Some specimens may be cut out from their holes by a skillful use of the knife or hatchet; others (especially the Buprestidæ) may be found resting on or crawling over the trunk in the bright sunshine, while the more nocturnal species may be found on the tree toward evening or after dark, when, of course, a lantern must be used. A large proportion of the species living in the trunks of dead trees also breeds in the dead branches of otherwise healthy trees, from which they can be beaten into the umbrella, or where the use of the knife is more practicable than in the large trunks. The trunks of freshly felled trees attract numbers of Cerambycidæ and Buprestidæ and have to be carefully looked over, while the drying foliage of such trees affords an excellent opportunity for the use of the umbrella.

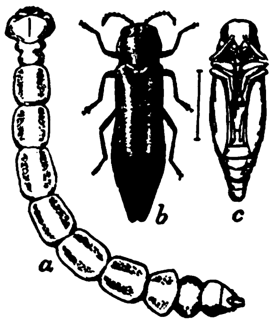

FIG. 126.—A BUPRESTID BEETLE, AGRILUS SINUATUS: *a*, LARVA; *b*, BEETLE; *c*, PUPA.

Beating living trees, shrubs, and vines.—The success of beating into the umbrella branches of living trees and shrubs depends on the particular kind of tree or shrub, on the condition and situation of these, and largely also upon the season. Pine trees are very productive from early in the spring to early in the summer, but much less so in midsummer and later on. Young oak trees or oak shrubs are much more preferred by the leaf-eating Coleoptera peculiar to this tree than the older trees. The beech, which, next to the oak, is the best tree for wood-boring species, harbors but few leaf-eating species. The leaves of the chestnut are also generally not attacked by Coleoptera; still a surprising number of species can be beaten from this tree when it is in blossom. There is not a single species of Coleoptera known to live in the wood or to feed on the leaves of the holly (*Ilex glabra*); still it will pay the coleopterist to beat this tree when it is in bloom. Trees, shrubs, and vines in the interior of unbroken forest districts are, as a rule, unproductive, while the edges of the woods, narrow strips of hedges, and especially solitary trees, are excellent collecting places. In the Rocky Mountains, especially in the more southern sections, long stretches of mountain slopes are occasionally perfectly bare of vegetation with the exception of a few solitary, sickly looking, and dwarfed trees, but every one of these is a veritable gold mine to the coleopterist with his umbrella.

FIG. 127.—A CARABID OR GROUND-BEETLE, CLIVINA IMPRESSIFRONS.

Sweeping.—The use of the beating net continues profitable from spring till fall, a different set of species appearing with each season. Low and swampy meadows, meadows on the slopes of mountains or surrounded by woods, low underbrush, and herbage in smaller patches of woods, are very good beating grounds. Dry and sandy meadows are less productive, but harbor usually a different set of species on account of the difference in the flora. Pastures and meadows much frequented by cattle and horses are much less productive, and where a large number of sheep are kept there is usually no chance for using the beating net, since neither grass nor specimens are left. The lawns in our parks and gardens are usually poor collecting ground on account of the limited variety of plants in such places; but the few species found there occur in enormous number of specimens. The endless stretches of our western prairies swarm at the right season (in June) with numerous Coleoptera (mostly Malachiidæ, Chrysomelidæ, Mordellidæ, Curculionidæ, etc.), provided prairie fires have not swept too frequently over the place. Fires and cattle produce a remarkable change in the flora and fauna of the prairies; many indigenous species disappear or become scarce and are replaced by a much smaller number of imported species.

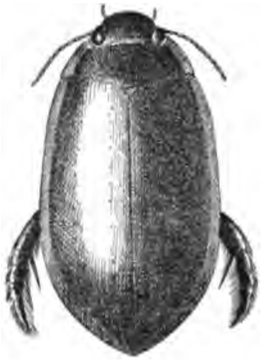

FIG. 128.—A WATER-BEETLE, DYTISCUS.

Sweeping may commence in the forenoon as soon as the dew has disappeared; it is less profitable in the heat of midday, but produces the best results late in the afternoon and more especially in the short interval from just before sunset until dark. At this time many rare Pselaphidæ and Scydmænidæ, species of the genera *Colon* and *Anisotoma*, and other small Silphidæ, can be beaten from the tips of grasses, all being species which can not, or only accidentally, be found during daytime, when they hide between the roots of plants.

Collecting on mud and gravel banks.—The mud or gravel banks of rivers, creeks, and stagnant bodies of water are inhabited, especially early in summer, with an astonishing multitude of Coleoptera. Countless specimens of smaller Carabidæ (*Dyschirius, Clivina, Bembidium, Tachys*, etc.) and Staphylinidæ (*Tachyusa, Philonthus, Actobius, Stenus, Lathrobium, Trogophlœus*, and many other genera) will be seen actively running over the mud or sand; many other specimens are hiding under the pebbles in company with other species (*Cryptohypnus, Georyssus*, etc.) or in little subterranean galleries (*Dyschirius, Bledius, Heterocerus*). All these beetles must be collected by picking them up with the fingers, an operation which, owing to the activity of the specimens, requires some little practice. The beginner will at first crush or otherwise injure many of the delicate specimens, the capture of which is moreover by no means facilitated by the rapidity with which most of them are able to take wing. The collector must necessarily kneel down, and he must not mind getting covered with mud. A good device for driving these species out of their galleries or from their hiding places under stones or in cracks of the ground is to pour water over the banks, and this can in most cases be done with the hand. Larger stones and pieces of wood or bark lying on the bank are favorite hiding places of certain larger Carabidæ (*Nebria*, *Chlænius*, *Platynus*, etc.), and should of course be turned over. Finally, the moss growing on rocks and logs close to the water's edge, and in which, besides other beetles, some rare Staphylinidæ and the Byrrhid genus *Limnichus* can be found, should be scraped off and investigated on the collecting cloth or on the surface of a flat rock, if such be conveniently at hand.

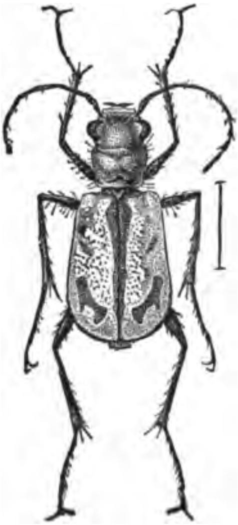
FIG. 129.—A TIGER-BEETLE, CICINDELA LIMBATA.

Collecting aquatic beetles.—The fishing for water-beetles in deeper water by means of the water net has already been alluded to, but many species live in shallow brooks with stony or gravelly bottom, where the water net can not be used. The Dytiscidæ and Hydrophilidæ living in such places usually hide under stones, and can in most cases be easily picked up with the hand, or a little tin dipper or a spoon will be found convenient for catching them. The species of the family Parnidæ are found on the underside of rough stones or logs which are either partially or entirely submerged. They are more numerous, however, in the moss or among the roots of other plants that grow in the water. Such plants have to be pulled out and examined over the collecting cloth.

Collecting at the seashore and on sandy places.—A large number of species belonging to various families live exclusively in the vicinity of the ocean, some on the open beach, others along the inlets, bayous, or salt marshes, and still others on the dry sand dunes. The Cicindelæ are actively running or flying about close to the water's edge and have to be captured with the butterfly net. The remaining maritime species live hidden under the seaweed and other débris cast up by the waves, or in the sand (sometimes quite deep below the surface) beneath the débris or between the roots of the plants growing on the dunes. The majority of the maritime species do not appear before June (in the Middle States), but the collecting remains good until September.

In dry sandy places away from the seashore, the collecting at the roots of plants is especially to be recommended, and the plants, and more especially the bunches of coarse grasses usually growing in such places, should be pulled up and shaken out over the collecting cloth. This mode of collecting acquires a great importance in the arid regions of the West and Southwest, where, in the warm season, nearly all Coleoptera are hiding during daytime in the ground at the roots of plants.

Collecting dung beetles.—The collecting of the numerous species Hydrophilidæ, Staphylinidæ, Histeridæ, Scarabæidæ, etc.) which live in the droppings of various animals is by no means an agreeable task. The collector should provide himself with a pointed stick and collecting tweezers, and must manage to pick up the specimens as best he can. The larger specimens are best collected in alcohol, while the more delicate species can be collected in a cleaner condition by removing the droppings and sifting the ground beneath the same. Some species hide deep in the ground beneath the droppings and have to be dug out. Summer freshets, when pasture lands are inundated, offer an excellent opportunity for collecting the dung-inhabiting species in a clean condition.

Night collecting.—The beating of trees and shrubs after dark is a good method of obtaining Lachnosternas and other species, and here the collector will do well to secure the assistance of a companion, who takes charge of the lantern and the collecting bottles, while the collector himself works the umbrella.

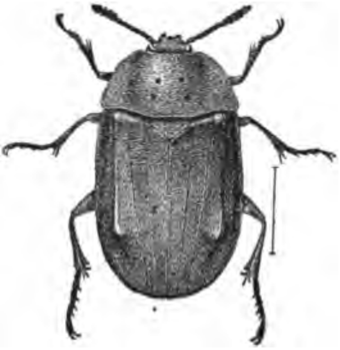

FIG. 130.—A SILPHID OR CARRION-BEETLE, SILPHA BITUBEROSA.

AUTUMN COLLECTING.—From the first of August the number of species gradually diminishes, but late in the summer or early in autumn quite a number of other species make their appearance, e. g., some Chrysomelidæ, Cerambycidæ, and many Meloidæ. Many of these frequent the blossoms of golden-rods, umbelliferous and other late-flowering plants. The fall is also the best season for collecting Coleoptera living in fungi. Although puff balls, toadstools, and the numerous fungi and molds growing on old trees, etc., furnish many species of Coleoptera also earlier in the season, yet most fungi, and more especially the toadstools, flourish best in the autumn, and consequently there is then the greatest abundance of certain species of Coleoptera. Decaying toadstools are especially rich, and should be sifted, and the collector should also not omit to examine the soil beneath them.

During the "Indian summer" there is usually a repetition of the "spring flight" of Coleoptera, though on a smaller scale, and collecting on the tops of fence posts and on whitewashed walls again becomes good. The first really sharp frost causes these late species to disappear, and winter collecting commences again.

LEPIDOPTERA.

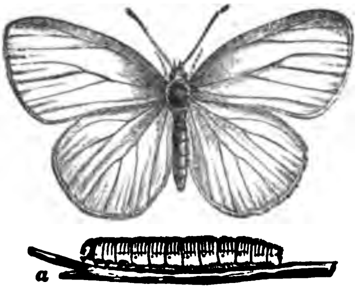

FIG. 131.—A BUTTERFLY, PONTIA OLERACEA, AND ITS CATERPILLAR.

The net for collecting Lepidoptera should be very light and of soft material, so as not to injure the specimens. Some lepidopterists prefer a net of gray or green material. Many species can be taken about flowers. It is usually better to take a butterfly in flight near the flower as it leaves or is about to alight, rather than when resting on the flower, for in the latter case one is apt to break off some pieces of the flower which, falling with the butterfly into the bottom of the net, may rub or tear the specimen. Avoid throwing a shadow upon the insect. When one is captured in the net, it should be clasped by the fingers from the outside with the wings folded together, and then by gently opening the net the mouth of the cyanide jar can be placed over it. Great care should be taken not to rub the specimen, as the scales are easily removed, leaving a blotch that ruins the specimen for the cabinet. Some collectors slightly pinch the thorax of the insect when captured. This prevents its fluttering too much in the cyanide jar. On a cloudy day, when flowers are swaying in the breeze, one may approach and place a cyanide bottle over a specimen without disturbing it. Moist spots by the roadside or in openings of woods are favorite localities for butterflies.

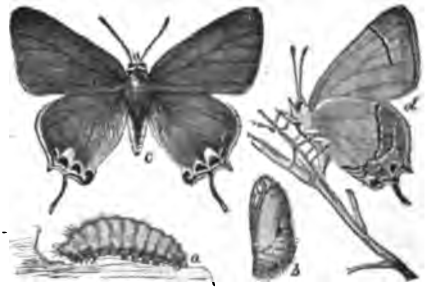

FIG. 132.—A BUTTERFLY, URANOTES MELINUS: *a*, CATERPILLAR; *b*, CHRYSALIS; *c*, *d*, BUTTERFLY.

It does not pay to chase butterflies, although if one misses a specimen at the first sweep of the net a swift, short run may sometimes bring success. "All things come to him who waits," provided he waits in a favorable spot.

Some butterflies are dimorphic; that is, the early spring brood is of a different appearance than the summer brood. In other species the males and the females are differently colored.

No other insects should be placed in the cyanide jar used to collect Lepidoptera, as the latter will be injured, and the other insects covered with scales. After the specimens are dead they should not remain longer in the cyanide bottle, else the yellow will turn to red. They should be pinned or papered in the field.

Many moths can be taken at night, and a trap light, as elsewhere described, is the best way to secure a lot of fine material. Sugaring, as described on page 47, is a prolific means of collecting moths. Many moths, as Catocalas and Geometrids, rest on the trunks of trees during the daytime. By carefully examining trees one can train the eyes to notice these insects when the casual collector would not see them. Mr. Merrick has devised a bottle with a trap spring cover attached to a pole for collecting Catocalas on trees above one's reach. It is described and figured in Entomological News, vol. 12, page 169.

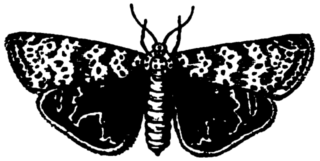
Fig. 133.—An Arctiid moth, Utetheisa bella.

The males of some of the larger moths are attracted to a female inclosed in a gauze cage, which may be exposed on warm, moist nights. In late summer and fall many moths rest upon dead leaves in the woods and fly up as one advances. One should be careful not to sweep up the leaves when one takes them, for the leaves will rub the specimens. Many of the smaller moths when captured in a net will partly walk and partly fly up the sides, and so may be taken in a small cyanide tube. The best way of obtaining perfect specimens of Lepidoptera is by rearing them. The caterpillars should be collected in a tin box, with a bit of their food plant, and taken home and placed in a breeding jar or cage. Directions for rearing are given elsewhere.

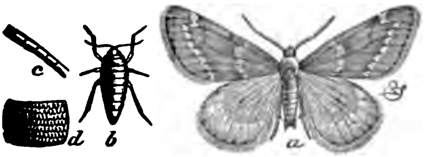

Fig. 134.—A canker-worm moth, Alsophila pometaria: *a*, male moth; *b*, female moth; *c*, *d*. enlarged parts.

Many moths visit flowers at night; by going to patches of bloom one may often secure varieties; the willow bloom in spring is very attractive; in fact, most flowers have some nocturnal visitants.

In collecting pupæ a trowel is one of the best tools. The best time is from August 15 on till November. They may be in soft soil or débris at base of trees, under dead leaves, among fallen pine needles, in rotten wood, in chinks of the bark of trees, or on the tree between fastened leaves. Arctiids (fig. 158) often pupate under the edge of stones, boards, etc. The pupæ should be disturbed as little as possible, and taken up with the leaves or bark to which they are attached. Pupæ should be placed in boxes with surroundings similar to those of nature. They are usually lain back uppermost, but the position is not important.

In collecting caterpillars the first thing is to overcome the repugnance which most people have to handling these creatures. They are practically all harmless, and do not bite, nor sting with the horn near the tail. A few species, like the bristly green caterpillar of the Io moth, the saddle-back caterpillar (fig. 135), and the caterpillar of the brown-tail moth, produce a sort of rash on the hands. Although painful for a time, it soon disappears, and one acquaintance will fix these species in the mind, so that the others may be handled without fear. Caterpillars should be picked up carefully, so as not to injure them, but with some of the large forms it is necessary to work their legs loose from the plant, to which they sometimes hold with wonderful tenacity.

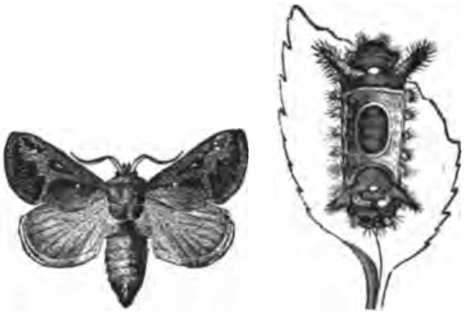

FIG. 135.—THE SADDLE-BACK, SIBINE STIMULEA: MOTH AND ITS STINGING CATERPILLAR.

Caterpillars may often be jarred from trees into the umbrella net before they have time to get a tight hold. After heavy storms one may find on the ground or at the bases of trees many caterpillars that have been beaten down by the rain and wind. Some of the caterpillars boring in stems of plants may be located by cautiously bending suspected stems in different directions.

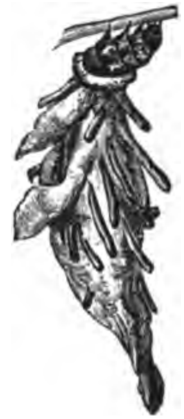

FIG. 136.—THE BAG-WORM, THYRIDOPTERYX EPHEMERÆFORMIS, FEMALE.

Early morning and late afternoon are the best times for discovering caterpillars. Many can be located by their droppings, or excrement, others by the partially eaten leaves. Some feed mostly at night, descending to the ground and hiding in the soil at base of the plant during the daytime. Many are protectively colored, and one must scrutinize the leaves and twigs carefully to find them. In the case of the solitary larvæ, when one has been taken, other plants of the same kind in the vicinity will possibly furnish other specimens. Whenever one finds a species in abundance, a goodly supply should be taken along, as some may be parasitized, and others may die before reaching the adult stage. Mr. Rowley often traps Catocala larvæ by leaning a pair of shingles against a tree. Bits of boards laid on the ground will offer concealment to many Noctuid caterpillars; lettuce and clover are also good baits.

Often one may find eggs attached to leaves, and from these one may rear and observe all the stages of the insect. A better way is to save captured gravid females and place them in a cage, with a probable food plant as an inducement to deposit their eggs. A bottomless barrel or nail keg placed over a plant and the top covered with mosquito netting makes a good cage. Various other cages are described in the chapter on rearing.

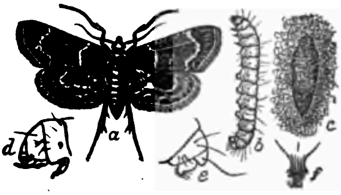

FIG. 137.—A PYRALID MOTH, PYRALIS FARINALIS: *a*, MOTH; *b*, CATERPILLAR; *c*, PUPA; *d*, *e*, *f*, DETAILS.

The Microlepidoptera, whose caterpillars mine or roll leaves, may be easily reared from injured leaves. Many Microlepidoptera are to be found flying at twilight over fields, especially at the edge of woods. A small light net will be useful in securing these. Many others rest on the bark of trees; these are taken by a small cyanide vial. Formerly most of the microlepidopterists collected these insects in pill boxes, killing them with a drop of chloroform on a pinhole in the box. Now, however, most prefer to collect them in small vials containing chloroform or cyanide. A great majority of these small moths are attracted to lights, and one may take hundreds of specimens and many species in one evening.

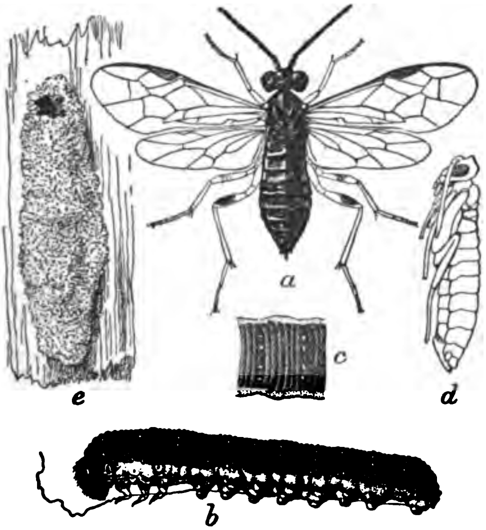

FIG. 138.—A SAWFLY, EMPHYTUS CANADENSIS: *a*, ADULT; *b*, LARVA; *c*, ENLARGED SEGMENT OF LARVA; *d*, PUPA; *e*, COCOON.

If one can not spread the Micros as soon as dead, they should be pinned (with micro-pins) in a small box, carried along for that purpose. After pinning, one should blow the wings lightly from behind, so as to separate the tips of the wings. If one expects to spread the specimens upon reaching home, the cork of the small pinning box may be moistened; this will keep the Micros from drying out.

Mr. Kearfott gathers the larvæ of the Microlepidoptera in glass vials, 3½ and 5½ inches long. In searching for these larvæ one must look out for their work; a crumpled leaf, a brown spot, or a withered shoot indicates the presence of the caterpillars. One must not try to remove the larva, but break off the abnormal part of plant and put it in the vial, keeping track by labels of the name of the plant.

In rearing material one should be careful to save for the cabinet some specimens of the larvæ, as well as the pupæ or pupal skins. These should be so labeled as to be readily connected with the reared insect.

HYMENOPTERA.

A great variety of bees and wasps may be gathered from flowers. A small or midget net suffices for most species, but the larger Pompilidæ (fig. 155) and Sphegidæ (fig. 140) are better caught in a large net. It is sometimes difficult to secure from the net a large stinging Pompilid. A few swift strokes of the net across the knee will assist in stunning the specimen without breaking it. Many bees can be picked from flowers with a forceps, or even with the fingers, as but few species can sting sufficiently to hurt, and one must expect an occasional thrust when collecting Aculeates. The specimens collected from each species of flower should be kept in separate cyanide bottles The larger Parasitica are to be found on shrubbery, in rather open woods or near the edge of woods, and most are easily caught with a net. Smaller forms will be found by sweeping herbage, and in the winter time many will be found by sifting moss, fallen leaves, and rubbish. Upon dead trees one may often find some parasitic Hymenoptera which are seeking to oviposit on the various larvæ in the trees. On warm, sunshiny days of spring one can sometimes find a variety of small forms on the fresh foliage of oak trees.

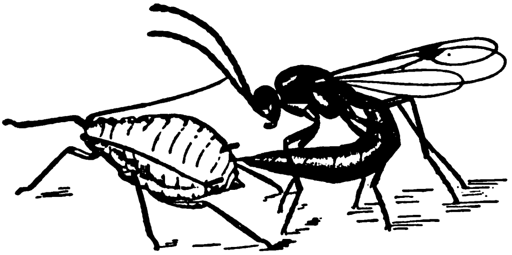

FIG. 139.—LYSIPHLEBUS DEPOSITING ITS EGGS IN THE BODY OF A GRAIN-APHIS.

The gall insects (fig. 70) may be reared from the mature galls, but it should be remembered that galls harbor many other insects than the makers, so that any species reared from a gall is not necessarily the maker of that gall. Moreover, some issue a year or more after the gall is mature. The sawflies (fig. 138) are chiefly found in the spring or early summer in shrubbery, tall herbage, and open groves, and on the young leaves of trees. They fall readily into the net, often playing 'possum. Any one who is rearing Lepidoptera and other insects should save the Hymenoptera that issue therefrom, giving each a label with name of host. Sandy spots furnish an opportunity to secure many fossorial forms. By waiting a bit around the holes and carefully watching the collector may obtain some of the parasitic species. Ants (fig. 159) can be secured anywhere, but it is better to get at the nests and so secure the different forms at one time. All the specimens from one nest should bear a number, as "Nest 16." They may be collected in alcohol and mounted up as desired. The social wasps and bumblebees may be gathered from the nests by visiting them at nightfall and introducing chloroform, or carbon bisulphide for those in the ground. One may thus gather all the different forms, which are not as yet known for many of our species of these insects.

The Micro-Hymenoptera are sometimes collected in alcohol, especially those obtained in sifting. These can be prepared for mounting, Mr. Crawford says, by removing them from the alcohol and placing them in chloroform for a few minutes, and then out on blotting paper. In many cases the genitalia of Hymenoptera are of value in determining the species. If the specimen is gently squeezed near the tip of the body the genitalia will sometimes be extruded. Otherwise they will have to be removed with a pair of fine scissors and scalpel and mounted on a slide or on a bit of cardboard attached to the pin. The nests and galls of Hymenoptera should be collected whenever possible. The galls may be pinned in the boxes, but a better way is to put them in flat pasteboard boxes of a size suitable to be arranged in rows in the box or drawer, with a label on the upper edge of each box indicating the contents. Casts of holes may be obtained by pouring into them mixtures of cement or plaster of Paris.

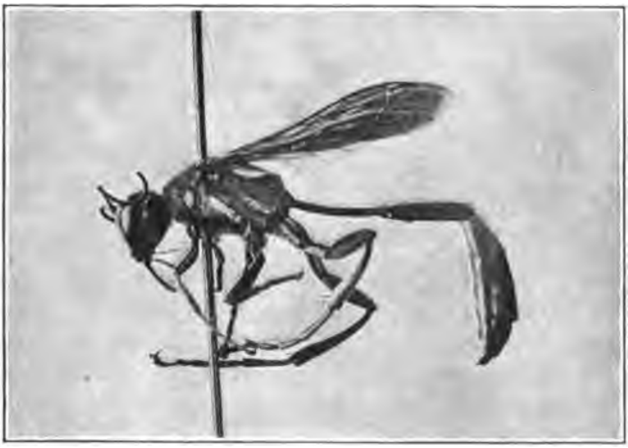

FIG. 140.—A FOSSORIAL WASP, AMMOPHILA NIGRICANS.

DIPTERA.

Although many of the brightly colored flies (fig. 156) occur on flowers, more different kinds can be obtained by sweeping herbage. In the latter case after one has taken a few strokes the end of the net should be twisted a little, and the tip with its contents placed in a large cyanide jar for fifteen or twenty minutes. On removal the insects will be dead, and one can pick them out leisurely. For flower collecting a small or midget net is very handy. Many species will be found in open groves or the borders of woods, on the trunks of trees, and on the leaves and shrubs. For these a light sweeping net is the best, one that can be handled with great rapidity. The gall-making species may be reared from the mature galls, and also those whose larvæ occur in fungi and under the bark of trees.

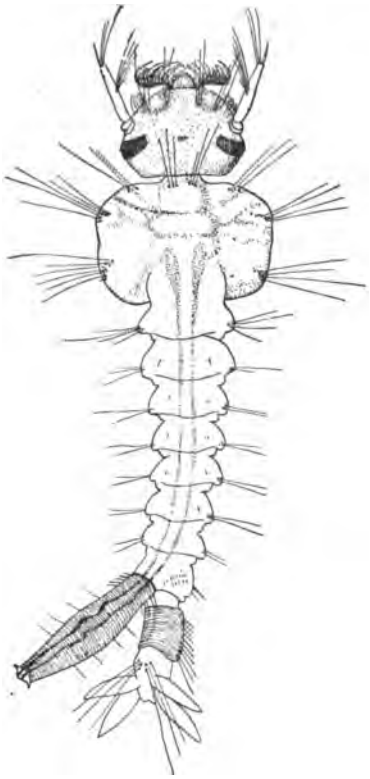

Fig. 141.—The larva of a mosquito, Culex.

Diptera suffer more than most insects from shaking about in the bottle or against heavier insects. Therefore it is well to collect them separate from other insects, and to have in the cyanide bottle plenty of crumpled strips of blotting or other soft paper. In many cases, especially with the long-legged kinds, they should be pinned in the field soon after capture. Many of the gall-flies (Cecidomyiids) are preserved mounted in balsam on slides. Doctor Dyar prefers to mount mosquitoes on points, but they are as well on micro-pins as a double mount. Many bristly Diptera should be pinned a little to the right of the center of the thorax, for a pin through the middle will destroy the bristles in the middle which are of value in classification. In the case of predaceous species the prey when observed should be put on the same pin as its captor.

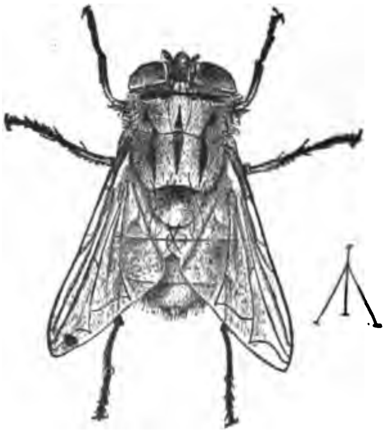

Fig. 142.—The screw-worm fly, Compsomyia macellaria.

With reared specimens it is often customary to mount the pupal skin on a bit of cardboard attached to the pin bearing the adult fly. The life histories of but few Diptera are known, and this is an inviting field for investigations.

Many horseflies (fig. 143) can be collected from a herd of cattle. With some hairy flies, like Bombyliidæ, it is better to kill them with chloroform, or pin them in the net and kill them later, for they lose many of their hairs in the ordinary cyanide bottle.

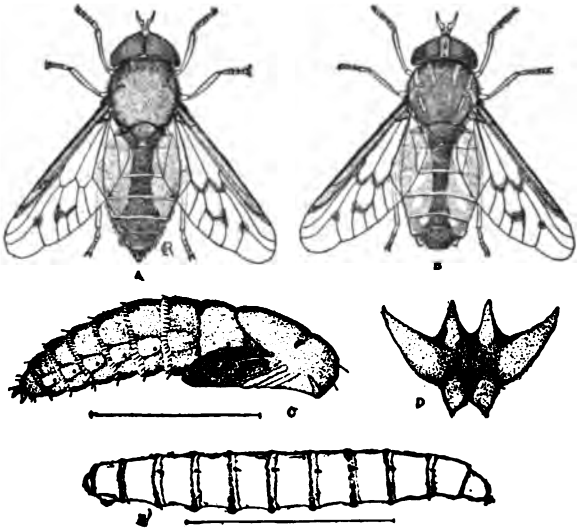

FIG. 143.—A HORSEFLY, TABANUS LASIOPHTHALMUS: *a*, MALE; *b*, FEMALE; *c*, PUPA; *d*, TAIL OF SAME; *e*, LARVA.

HEMIPTERA-HETEROPTERA.

The habits of the Hemiptera-Heteroptera are in many ways similar to those of the Coleoptera, and one who collects beetles will come across a great variety of bugs. A number are found on the ground, others in or on the water, some on the bark and twigs of trees, many species on the leaves of trees and shrubs, under stones, among fallen leaves, and in moss. A few are obtained by sweeping, and most of them by looking in likely situations, and the forceps and empty vial are the most useful instruments. A number may be taken with the umbrella net. Many of the aquatics, and some of the Reduviids (fig. 144), come to light. Many species are restricted to one or a few food plants, so that food-plant labels should be pinned with the specimen. When one takes a number of Tingitidæ or Aradidæ it is well to mount a few specimens upside down, as the venter is of importance in classification. Frequently it is necessary to mount the wings and heads as dry mounts on slides for microscopic study.

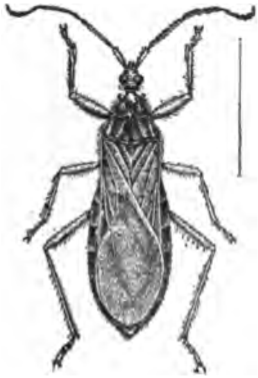

FIG. 144.—A "KISSING BUG," REDUVIUS PERSONATUS.

Many Heteroptera hibernate in the adult condition under the loose bark of dead trees, on the ground under fallen leaves, or under pieces of wood in fields. By searching in such places late in the autumn or early in spring one may obtain many varieties.

For the large family of Capsidæ (fig. 21) June is the best season. Sweeping herbage, meadows, and the foliage of trees will bring many of these fragile insects into the net.

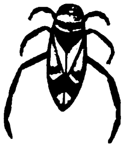

FIG. 145.—A WATER BOATMAN, NOTONECTA IRRORATA.

The best times of the year to collect aquatic Hemiptera (figs. 145, 146), Mr. Bueno says, are the spring and autumn. Mr. Bueno uses a couple of water nets, cyanide bottles of several sizes, tin boxes for living specimens, and a pair of rubber boots. These insects should not be collected in alcohol, except for anatomical purposes, and should be mounted as soon as possible. The water-bugs can be easily kept in aquaria, but since many are predaceous one can keep only a few in each vessel.

HEMIPTERA—HOMOPTERA.

The Homoptera may be obtained by sweeping herbage or beating trees. Many of them are mounted on points, but some may be pinned with micro-pins as double mounts. Some species occur commonly in a short-winged or brachypterous condition; one should look carefully in the proper situations for the macropterous or long-winged specimens. It is well to have one or two specimens of each species with the wings spread, as these organs are sometimes colored and the dorsum of the abdomen has bright markings. The plant-lice (fig. 26) may be collected in alcohol, but are better brought home in tin boxes and mounted in balsam on slides. It is well to take note of their colors before killing them. It is necessary to obtain the various forms and stages, so that the same plant should be visited at different dates; some species migrate to other plants in the latter part of the season, so that one will have to search around to find this alternate food plant.

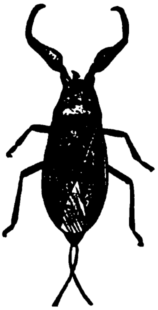

FIG. 146.—A WATER-BUG, NEPA APICULATA.

The scale insects (fig. 149) should be collected with a bit of twig or leaf on which they occur and pinned in the collection. A better way is to put them in flat pasteboard boxes of a size to fit well in rows in the cabinet, and then a label pasted on the upper edge of each box indicating its contents. Mr. Sanders has prepared the following account of his method of mounting scale insects on slides:

The greatest care in manipulation is necessary to secure a good mount of a scale insect. Various simple and complex methods have been used by students of Coccidæ, but the media most generally used for mounting are glycerin jelly and Canada balsam. After a long trial glycerin mounts have proved very unsatisfactory, even when carefully mounted and ringed with a supposedly impervious cement.

Diaspine scales.—Diaspine scales are boiled in caustic potash, the method of boiling varying from a few seconds to half a minute for the very strongly chitinized species. Specimens thus softened and partially cleared are transferred from the tube directly to a microscope slide and carefully washed with warm water with the aid of a pipette. Washings with 95 per cent alcohol follow, and the scales are then floated to the center of the slide and arranged in a line, with the pygidia pointing in one direction; after which the alcohol is removed with bibulous paper. Before the alcohol is entirely evaporated a small drop of oil of cloves is applied and slightly heated to drive off the bubbles of air and to cause the oil of cloves to penetrate the specimens. The oil of cloves having been removed, a very small drop of balsam is added and a clean cover glass is applied and held in place with a steel clip while the slide is heated for a few seconds over an alcohol lamp to dry the balsam. If care is used, the balsam can be quickly dried, so that upon cooling it is perfectly hard. Fifteen to twenty minutes are ordinarily needed for such preparation.

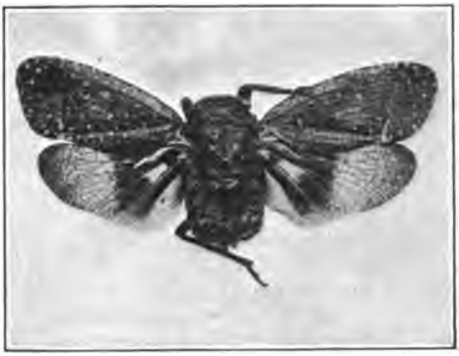

FIG. 147.—ONE OF THE FULGORIDÆ, POIOCERA FULIGINOSA.

Nondiaspine scales.—In mounting the soft-bodied scales various methods are necessary for clearing the insects on account of the remarkably diverse coverings which they produce. With the lac insects and species of the genus *Ceroplastes* it is often necessary to boil the specimens in chloroform or acetic acid to remove the wax. Mealy-bugs and Lecaniums can be immediately removed to the potassium hydroxide and boiled similarly to the diaspine scales. However, it is frequently necessary to boil the specimens for a long period, and also to prick holes through the body wall to allow the escape of the body contents. After boiling, the specimens are washed in warm water, and dehydrated with two or three grades of alcohol, then arranged upon a slide, and clove oil or xylol applied preparatory to mounting in the usual way in Canada balsam In mounting very convex species it is frequently necessary to slit the

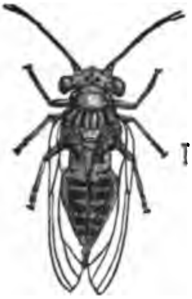

FIG. 148.—ONE OF THE PSYLLIDÆ, PSYLLA PYRICOLA.

margin of the scales so that they will lie flat upon the slides. Great care must be exercised to secure a good mount of such soft-bodied scales as the mealy-bugs, it being necessary to float the specimens onto the slide and handle them with extreme care to prevent them from curling and folding. Canada balsam having been placed on the insect and the cover glass applied, the slide is heated as in mounting the diaspine scales.

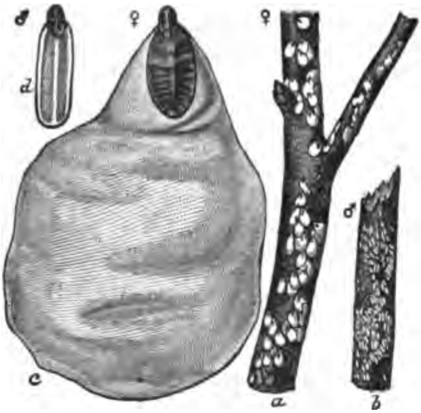

FIG. 149.—A SCALE INSECT, CHIONASPIS FURFURUS: *a*, FEMALE SCALES; *b*, MALE SCALES; *c*, FEMALE ENLARGED; *d*, MALE ENLARGED.

Sometimes it is desirable to stain the specimens. This should be done while the insect is immersed in alcohol, or at least before xylol or clove oil is applied. One of the very best stains which has been used for this purpose is ordinary carmine ink, which can be used in conjunction with weak alcohol.

Another method of mounting the insects in situ for superficial examination was originated by Prof. Herbert Osborn, of the Ohio State University. Diaspine scales or any flat scale insects when perfectly dry can be readily mounted between two strips of mica of the same dimensions as the ordinary microscope slide with the passe-partout method—i. e., the edges of the mica are sealed by means of gummed strips. Specimens mounted in this way are available for easy examination, and can be filed along with the ordinary slide mounts.

The Anoplura, or lice, may be collected on the domestic and wild animals and should always be mounted in balsam on slides.

ORTHOPTERA.

A large number of Orthoptera can be obtained by sweeping meadows and herbage. Many of the crickets occur on the ground; others are to be found on shrubbery. Roaches (fig. 11) are found under loose bark of trees, among rotten logs and fallen leaves. Most of them found are young, but by looking at different times one will find the winged ones, usually in May or June. Their egg-cases, or ootheca, should be saved, as that of each species has a characteristic

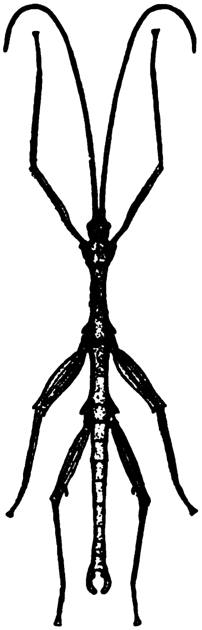

FIG. 150.—A WALKING-STICK, MEGAPHASMA DENTICRUS.

appearance. Some Orthoptera occur on trees; these are frequently attracted to lights. The grouse-locusts (*Tettix*) are most common on moist, dark soil. The more active specimens resting on the ground may be taken by suddenly placing the net over them. If they do not readily fly up, the net may be pressed on the ground and one can feel the specimen.

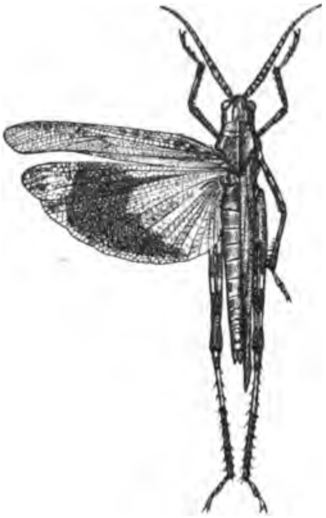
FIG. 151.—A GRASSHOPPER. PSINIDIA AMPHICORNIS.

Few, if any, insects reflect the nature of their surroundings better than the Orthoptera. One can tell by the specimen whether it was taken on light or dark soil, in a wet or a dry situation, in the shade or exposed to the sun.

So responsive are their external tissues to their environment that it is among the Orthoptera we find the most remarkable examples of protective resemblance. They are therefore the most convenient group for ecological studies, and for this purpose a label indicating the nature of the locality should be pinned with each specimen.

The large, fat-bodied Orthoptera often shrink so much in the cabinet that many orthopterists slit the base of the venter with a pair of fine scissors, remove the abdominal contents, and stuff with cotton, taking care, of course, not to distend the body.

NEUROPTEROIDS.

The Odonata, or dragonflies (fig. 9), can usually be found flying over ponds or streams; others will be taken in openings or paths of woodlands. Many of them have the habit of returning over and over again to the same stick or twig to rest, so that by waiting near by one is apt to get a good chance to capture the insect. For these insects a light net is necessary and a fairly long handle. These insects are expert dodgers, and one must strike quickly, and a stroke from behind is fully as apt to take the specimen as one from in front. Sometimes in the early morning one can find the nymphs on grasses near

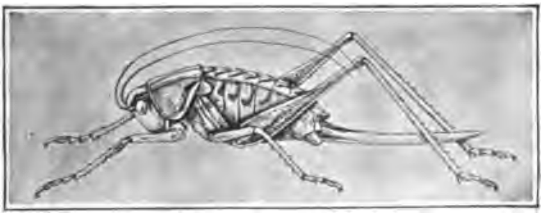
FIG. 152.—A WESTERN CRICKET, OF THE FAMILY LOCUSTIDÆ, STEIROXYS TRILINEATA.

the pond, transforming to the adult. If these are taken and kept alive for a day, they will attain their full coloration. Each specimen should have a hog bristle inserted into it from the head through to near tip of abdomen to keep the specimen straight and to prevent the loss of abdomen and head. Straight pieces of broom from a whisk broom may be used for the larger forms.

Many other Neuroptera, as caddiceflies, stoneflies, and mayflies, are attracted to lights placed near ponds and streams. During the day these insects often rest under the leaves of shrubbery near the water. The Psocidæ are most common on the trunks of trees or on fences in summer and early fall. By searching carefully over the bark of oak, tulip, chestnut, maple, and other trees one will nearly always find a few of them. One should have a supply of small, empty vials, placing one over each specimen. The Psocid may be made to fly into the vial by tickling it with a bit of grass or a toothpick pushed under the edge of the vial. From the vial they may be shaken into a small cyanide bottle in which are crumpled strips of soft paper. They should be pinned with micro-pins as soon as possible after death. The mayflies are so fragile that many are better preserved in alcohol. When one finds the subimago of these insects, it may be kept in a wooden box until it molts to the adult. It is useful to save one or two subimagoes of each species, since these have a characteristic appearance. Caddiceflies (fig. 163, *a*) can be obtained by sweeping the foliage of bushes and trees near streams and ponds. All of the Neuropteroids can be collected and shipped in envelopes just as Lepidoptera.

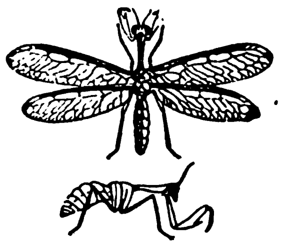

FIG. 153.—A MANTISPA, WITH SIDE VIEW BENEATH. (FROM PACKARD.)

Mr. Bignell preserved the colors of dragonflies as follows:

> Directly after death, clean out the contents of the thorax and abdomen. To do this, obtain a long darning needle, thread it with a short piece of fine cotton, tie the ends together so as to form a loop; sling into this loop one or more strands of cotton or silk, according to the size of the insect. For the largest, four strands may be used. This would give eight threads in the thorax and abdomen, taking care to select the cotton or silk of the predominant color of the fly. Then pass the needle into the fly, directly under the head, through the thorax and abdomen, pulling the cotton or whatever is used through the body until it comes out quite clean. Then slide the abdomen up a little, cut off the end of the material used, pull the abdomen down to cover it, then cut off close under the head, leaving the remainder in the body. The fly will then be ready for setting.

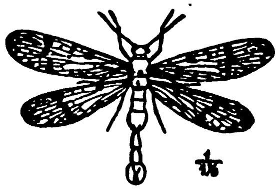

FIG. 154.—A PANORPA, OR SCORPIONFLY. (FROM PACKARD.)

Some have used artificial heat to preserve the coloring of dragonflies.

SPECIAL KINDS OF COLLECTING.

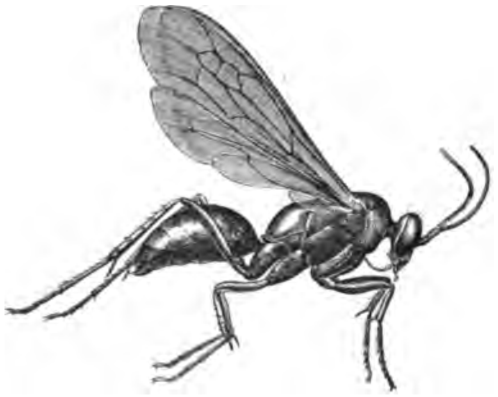

FIG. 155.—ONE OF THE POMPILID WASPS, PRIOCNEMIS.

It is of great interest to any observer to find out what occurs in a certain place or under certain conditions. For example, the insects that are associated with ants, that are to be reared from fungi, that occur along the seashore or in caves, or to be taken from a certain kind of flower. This group or ecological collecting is of increasing biological interest, since it shows what insects are associated with each other, compete with each other, and may influence each other's life. Many prominent biological questions are opened by this collecting, such as isolation of allied species. Some of the principal lines of this kind of collecting are noted below. All specimens collected under like surroundings should bear a label indicating the fact.

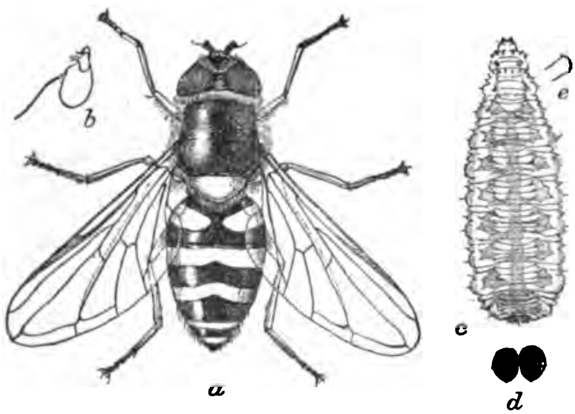

FIG. 156.—ONE OF THE SYRPHIDÆ, SYRPHUS RIBESII: *a*, FLY; *b*, ANTENNA; *c*, LARVA; *d*, *e*, DETAILS.

Flowers.—It will soon be noted by any one observing insects that certain species prefer certain flowers. This is especially noticeable among bees, but many Diptera (fig. 156) also show such preference. Other insects prefer flowers of a certain color. By watching certain flowers year after year one will pick up many rare forms that would not have been captured by desultory collecting, and at the same time gather many facts about habits and occurrence of insects that are as yet far too little known to entomologists. For taking insects from flowers one should not use a large or heavy net. It is apt to break the blossoms so that they will attract but few insects on following days, and a large net is apt to frighten away other insects from nearby flowers. A midget net will be found useful for much of this collecting. Many species of wasps and bees can be taken from flowers with a fine forceps. Others can be captured with the fingers, as few bees can sting severely. The captures from each species of flower should be kept in separate cyanide bottles, and on pinning should have a label with the name of the plant.

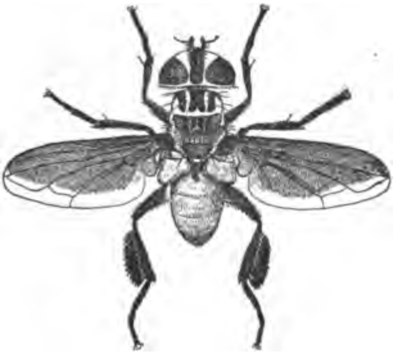

FIG. 157.—A TACHINA FLY, TRICHOPODA PENNIPES.

Soil collections.—It has long been noted that sandy places, such as sea beaches, are inhabited by a peculiar set of insects; a few of each order. These are modified to suit their surroundings, often protectively colored, of strong flight, or resistant to submersion in sea water. Other kinds of soils have also a peculiar fauna, although hardly as striking as that of sandy beaches. A low, wet spot with black soil will have its peculiar forms of grasshoppers, Hemiptera, Coleoptera, etc. In this kind of collecting one must often get on his knees, and, bending close to the ground, watch for any moving object as he carefully pushes aside the leaves and sticks. A fine forceps is the best instrument to pick insects from such situations.

Fungi.—The various fungi that are so abundant in our woods in summer and autumn conceal hosts of insects. Until one systematically gathers and breeds them one has no idea of the wealth of material. Fungi in different conditions afford food for different insects. Nowadays it is quite possible to have the fungi identified by specialists in mycology, so that one may label the specimens with the name of the fungus from which it was bred. The fungus, if moist, should

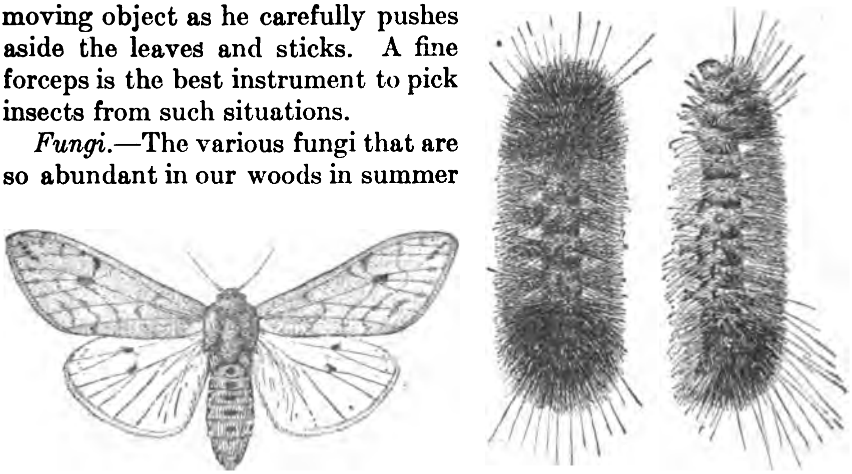

FIG. 158.—THE SALTMARSH MOTH, ISIA ISABELLA, FAMILY ARCTIIDÆ: MOTH AND CATERPILLAR.

be placed in a tin box, and, if necessary, braced with twigs so that it will not shake about; if a dry species, it may be wrapped up closely in a piece of stout tissue paper and carried home in any kind of box. Some fungi require wet or a moist atmosphere for the development of these insects, and these should be taken up with some soil about them and placed in a jar or cage where the soil can be kept wet. Other fungi, particularly those on the bark of trees, may be kept in a dry jar or jelly glass until all the insects have issued from them. In many cases the larvæ pupate in the soil under the fungus, and so it is useful, especially with beetle larvæ, to have soil under the fungus in the breeding cage.

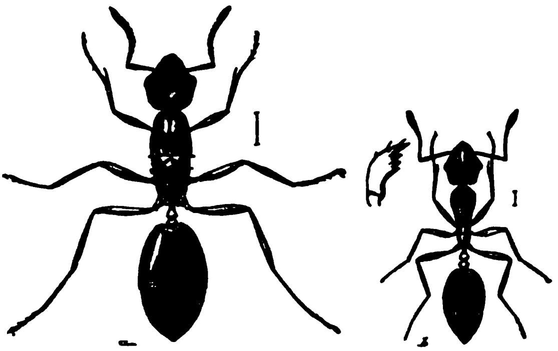

FIG. 159.—AN ANT, MONOMORIUM PHARAONIS: *a*, FEMALE; *b*, WORKER.

Ants' nests.—Ants' nests harbor many curious insects outside of the rightful owners. These insects are known as "Myrmecophiles." Some are tolerated or even fostered by the ants; others are their unwelcome guests; they are rats, and mice, and fleas. To secure these insects one must examine the nest and sift its material. Many of the ant guests are beetles, and these have been discussed by Mr. Schwarz. The nests of white ants or termites also have their guests. These are known as "Termitophiles."

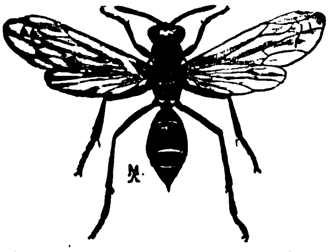

FIG. 160.—A WASP OF THE FAMILY VESPIDÆ, POLISTES BELLICOSUS.

Wasps and bees.—Many wasps (fig. 160) and bees nest in colonies, and if these colonies are large it will be soon noted that a number of other insects can be found around the holes or reared from the nest. When one discovers such a colony he should visit it several times and secure the numerous insects that are associated with the wasps and bees.

Galls.—Many insects can be reared from galls, aside from the gall-makers, there being numerous insects called "inquilines" which occur with them. Beetles and Lepidoptera are sometimes obtained from galls made by other insects.

Moss.—Many minute insects find in that tiny forest we call moss a most hospitable shelter. Numbers of mites, small spiders, and spring tails, many beetles, and a great variety of Hemiptera as well as some delicate flies are here at home. In the winter time there are also many of the Micro-Hymenoptera. The best way to get at this hidden fauna is by sifting the material through a sieve net, but one can obtain many specimens and learn a great deal about the habits of these pygmies by getting down on his knees or lying prone and picking away the moss. These specimens should be labeled as from moss, and when possible one should give the name of the moss.

Nests.—A considerable number of insects occur in the nests of birds, moles, mice, and other animals. The material can be sifted, and sometimes, if kept in a jar, one may breed a number of these insects.

Excrement.—The droppings of cattle are rich in insect inhabitants. Many of them breed or feed in the material, while quite a number are predaceous and feed on the other insects. The manure may be placed in a pail of water and the insect inhabitants will float to the surface. Some of the species burrow in the soil under the manure, and if one wishes to rear them it is necessary to take up this as well as the manure to the breeding cage.

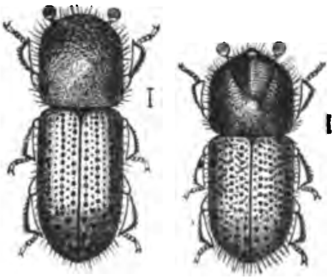

FIG. 161.—A SCOLYTID OR ENGRAVER-BEETLE, XYLEBORUS PERFORANS, MALE AND FEMALE.

Dead animals.—Many beetles and flies are attracted to carrion and the parasitic Hymenoptera to oviposit in their larvæ. One visit will not be enough, as later one may find different species from those captured on the first trip. Many species that occur in carrion may be trapped by placing a few bits of wood or bark on the ground near the body. The specimens if soiled may be cleaned in benzine or gasoline.

Forest insects.—The collection and study of insects injurious to forest trees has developed new tools and methods; these are briefly summarized by Doctor Hopkins as follows:

The equipment for collecting specimens need not be expensive or elaborate. The necessaries are: A hatchet or light ax, carried in a scabbard, which may be fastened to a stout belt; a hunting coat, or an ordinary sack coat, with many pockets; a supply of collecting vials of various sizes, fitted with the best cork stoppers; a small bottle of alcohol; a medium and a small cyanide bottle; tweezers; camel's hair brushes; a stout knife with small and large blades; a small saw; a net, and umbrella; and last, but not least important, a notebook and pencil. With this equipment, or such part of it as is required for the special kinds of specimens desired, a good observer can go out in the woods any day in the year and find plenty of material.

The best places to collect species infesting wood and bark are along the edge of the woods, or where trees have been girdled or felled a few months previous. Here one will usually find in the bark of the roots, stumps, main stems, tops, branches, and twigs different stages of many species of barkbeetles and bark-inhabiting larvæ, together with their natural enemies and associates; and the wood will yield many more.

Lumbering regions and sawmill yards are especially prolific in specimens at all times, as are also broken branches, individual trees, and groups injured or killed by insects, felled by storm, or otherwise rendered attractive to insects. During the spring, summer, and fall the foliage will yield specimens almost unlimited in number and variety. But one should remember, as has already been indicated, that it is not the number and variety, but those of most importance that are to be sought out, noted, collected, and studied. It is often better to spend a day in the diligent search for all that can be found in or on a single tree, or in observing and recording in the notebook all that can be found out about a single species, than merely to collect hundreds of specimens or many species without careful records.

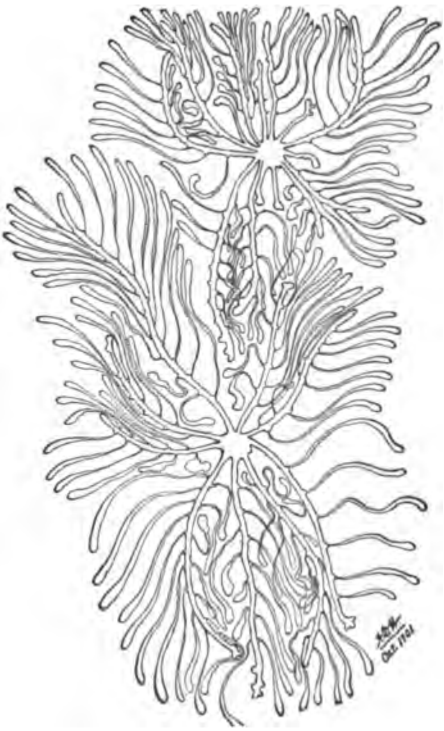

FIG. 162.—GALLERIES OF A SCOLYTID BEETLE, PITYOGENES CARINICEPS.

Indeed, the proper recording of what one sees at the time the observations are made is of the greatest importance, and is the one thing the student should practice more, perhaps, than anything else.

The collector should be constantly on the lookout for the natural enemies of the principal injurious species. One class of the enemies of insects consists of parasitic Hymenoptera, Diptera, etc., found in the adult, larval, or pupal stage, associated with their host, the larvæ as external or internal feeders on the larvæ, pupæ, or adults of the injurious species, and the adult parasites ovipositing on or in the victims, or in the bark or other infested parts of the plant. The insect enemies of the other class are predatory species of Coleoptera, Hemiptera, Hymenoptera, and other kinds of insects which attack and kill their victims, and either devour them or suck out the liquid parts of their bodies. There are also insect diseases which may be indicated by a white powdery substance on the bodies of the dead insects, and whenever numbers of examples are found to be dead or dying, specimens should be collected and submitted without delay to some specialist on this class of diseases.

The specimens of work of insects should have the surplus parts removed, and should be labeled and stored where they will be readily accessible for future reference. Broad shallow drawers or trays are convenient for the smaller wood and bark specimens, while wood or heavy paper boxes serve for larger ones. Common florists' paper boxes, which are shipped flat ready to be made up, are excellent for storing the classified material.

Every individual specimen, mounted set of alcoholic specimens, specimens of work, etc., should bear the note number referring to it in the notebook.

Aquatic collecting.—By watching a certain pond or stream for several years one will find it full of insect life. The number of species there associated together in their different stages is remarkable. Doctor Needham has devised a method of gathering these insects from a limited area of the water. He erects a tent of white muslin over a favorable spot in the stream, and fastens the edges down close to the water. A flap is left so that one can enter each morning and gather the insects that have issued during the night. Mr. Roberts has shown that one may gather many rare aquatic insects from a stream by stretching a net across it and disturbing the pebbles and stones above the net. The loosened insects will float down-stream against the net.

Most of the aquatic insects can be carried home alive, wrapped in wet waterweeds. Sometimes one can find insects transforming; these may be collected and carried home in paper bags, where, in a day or two, they will attain full development. In this collecting one should be careful to save the moulted skins. By closely observing one particular stream or pond one can often connect the insects with their larvæ without the necessity of rearing them.

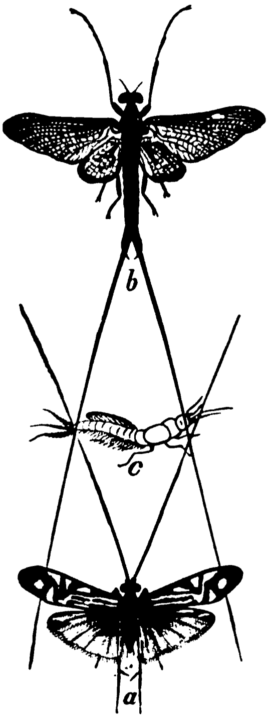

FIG. 163.—*a*, A CADDICEFLY, MACRONEMA ZEBRATUM; *b*, A MAYFLY, HEXAGENIA BILINEATA; *c*, ITS LARVA.

INSECT BOXES AND CABINETS.

Insects should be kept in a tight, dry, and dark place; tight to exclude insect pests; dry to prevent mold; and dark to preserve the colors. Light will gradually fade the colors, so that if glass-top boxes are used they should be placed in a dark cabinet. There are two styles of insect boxes, the small box about 10 by 12 inches with a hinged cover, and the drawers about 18 by 20 inches, with a removable cover and which slide into a case or cabinet. The small boxes are usually stood up on one of the long edges. The drawers are by far preferable for most insects, and are especially useful in museums, or for large and valuable collections. Beginners sometimes use empty cigar boxes, lined with pith or cork. These, however, are not tight, and should be used only for temporary storage of recently collected specimens. Pasteboard boxes, if kept in a well-dried place, are useful for beginners, and may be purchased cheaply from the dealers in insect supplies. The small folding boxes, about 10 by 12 inches, are used by a great many entomologists.

There are several makes of these boxes, the best being the Schmitt box (fig. 164), which has the top and bottom of two thin pieces cross-grained so as to prevent warping. The top fits down tightly over a raised ledge of the lower part. They are best made of well-seasoned pine, white wood, or linden. The Schmitt box is usually 8½ by 13 inches, but a size 12 by 15 inches is also for sale. The bottom is lined with pressed cork, or, what is better, patent cork. Sheet cork is still better, if one can afford to buy the best quality. Most of the dealers also make a cheaper box similar to the Schmitt box, but without a double top and bottom. A metal case is now manufactured for holding Schmitt boxes in a horizontal position. Each metal case holds two rows of fourteen boxes, and is provided with a clasped cover, which keeps out the dust, as well as pests. The drawers are made of various sizes—18 by 23 inches is often used for Lepidoptera; others use 16 by 20 inches. These commonly have a glass top and fit into a glass case or cabinet, holding sixteen to twenty, which is better if closed by doors. These drawers often have a hardwood front, and the cabinets are sometimes expensively made so as to be an ornamental piece of furniture.

The U. S. National Museum uses a drawer 18 inches square and 2½ inches deep (figs. 165, 166). The box has an inside partition inclosing a space about one-fourth inch wide all around, which is filled with flake naphthalene to form a poison chamber (*d*). The sides are of mahogany and the bottom is of three-ply, cross-grained veneer, and is covered with patent cork (*b*) and lined with white paper. The cover is of glass, fitting into a flat frame three-fourths inch wide with a one-fourth inch tongue, which fits into the space between the inner and outer boxes. A groove (*g*) is made in the sides of the drawers, upon which they slide on a strip in the cabinet. The cabinets now being used are of metal, a double tier, the lower box of thirteen the upper of twelve drawers. These cabinets have a removable metal cover. Formerly the drawers were 3 inches deep and fitted into double wooden cabinets, holding twenty drawers and closed by paneled folding doors. These drawers can be made more cheaply if of some other wood, as pine or white wood. It is well to have a small label holder attached to the end of the box, or front of the drawer. Formerly double boxes, or book boxes, were very popular with some collectors, two boxes of about 10 by 12 inches hinged together, one serving as the top of the other, and each of the same depth, so that insects may be pinned in each box. They are stood up on ends and the backs covered to resemble books.

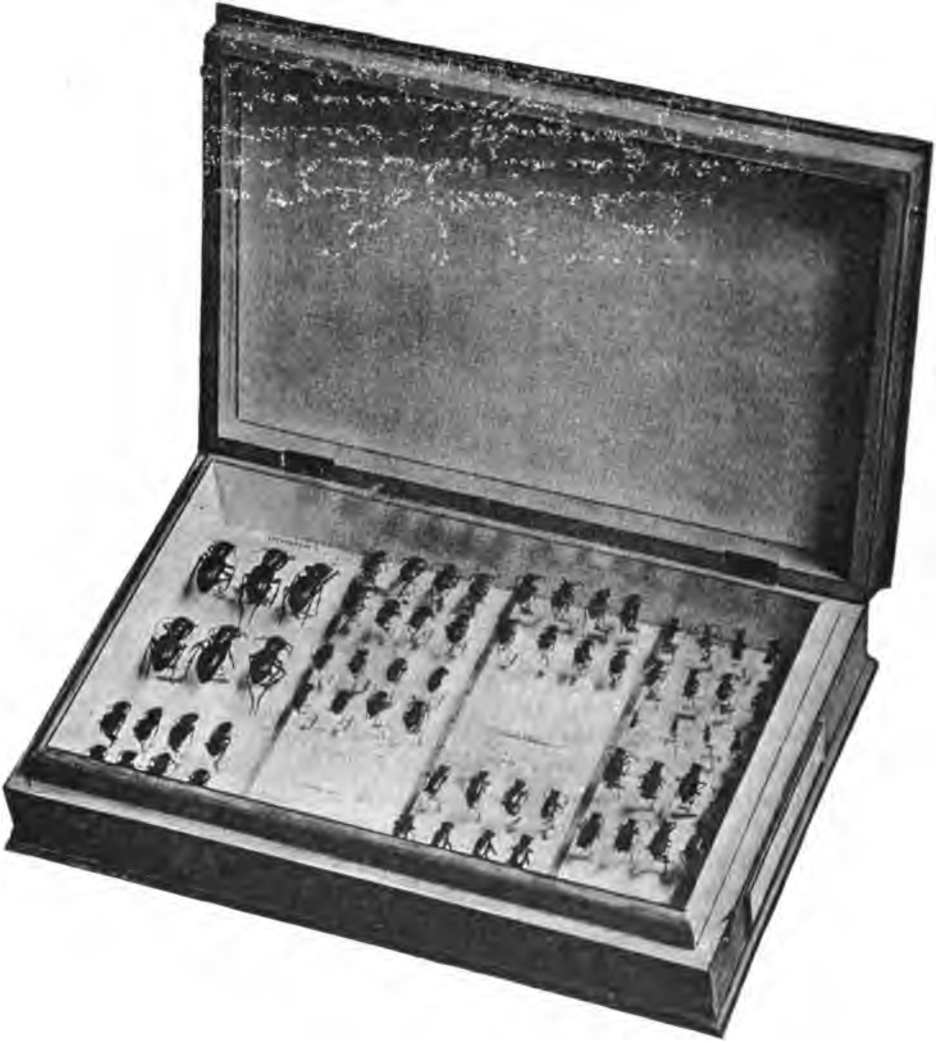

FIG. 164.—THE SCHMITT FOLDING INSECT BOX, OPENED AND SHOWING ARRANGEMENT OF INSECTS.

The Museum of Comparative Zoology keeps its insects in drawers 15 by 18 inches, inside measurement. The drawers are in double cabinets with hinged doors, holding nine drawers each. No cork is used in the bottom, which is made of soft wood, so that a pin may be inserted into it. The tops are of glass, and the frame has a groove which fits very tightly over a tongue from below. The tops are held down closely by hooks and eyes. Professor Comstock uses a drawer with glass bottom as well as top. A number of small flat blocks, arranged in rows, cover the bottom. The cork is fastened to each block. One species or genus can be pinned on each block and the block transferred to a different part of the box, if desired, without handling the specimens.

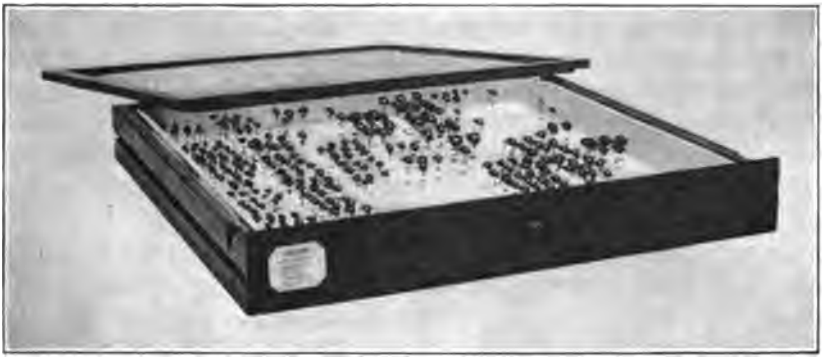
FIG. 165.—THE U. S. NATIONAL MUSEUM DRAWER, SHOWING ARRANGEMENT OF SPECIMENS.

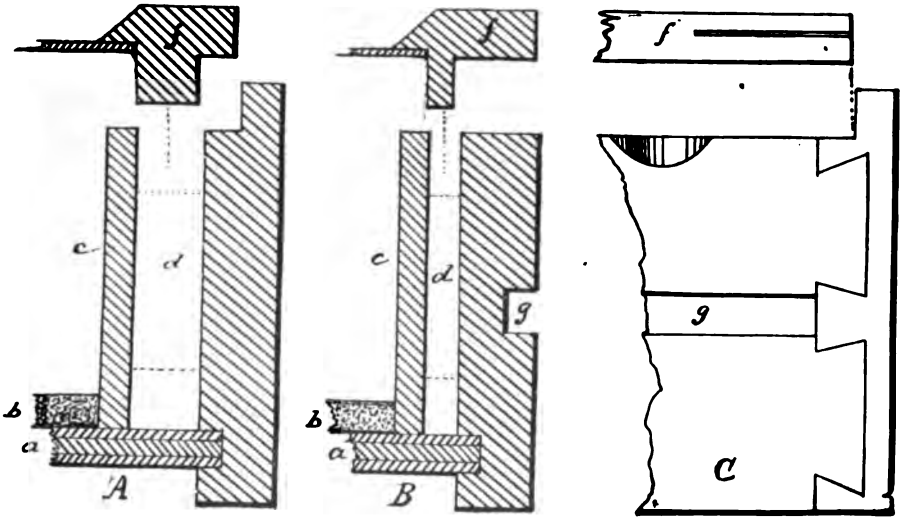

FIG. 166.—CONSTRUCTION OF THE INSECT CABINET DRAWER OF THE U. S. NATIONAL MUSEUM: A, CROSS-SECTION OF FRONT; B, SAME OF SIDE; C, VIEW OF FRONT END OF SIDE, TWO-THIRDS NATURAL SIZE. *a*, BOTTOM; *b*, CORK LINING; *c*, INSIDE STRIP FORMING NAPHTHALENE POISON CHAMBER; *d*, NAPHTHALENE POISON CHAMBER; *f*, TOP; *g*, GROOVE.

The Carnegie Museum uses a drawer 16 by 22 inches and 2 inches deep inside. The top is of glass. The sides have a pocket on the inner edge. The paper over this pocket is perforated with small holes. Naphthalene crystals are placed in the pocket and the fumes reach the interior of the box. Mr. Martindale had his Lepidoptera in drawers with glass bottom and top. Across the bottom were narrow strips of cork, supported in narrow tin frames. The specimens are pinned into this cork strip, and by turning the box upside down, one can see the underside of the insect. For large insects only four or five strips were used in each box; for smaller forms ten or twelve strips. Each strip was fastened at its upturned edge by a thumb tack to the end of the box.

The Deyrolle drawers used by some entomologists are light boxes about 15 by 18 inches, with a narrow strip of zinc set edgewise all around the top of the lower part of the box. The cover is glass, and the frame of cover has a narrow groove to fit over the strip of zinc. They are very tight, and for some insects too tight, as one has to lift up the top very gradually else the suction will break the wings of frail specimens. These Deyrolle drawers are lined with either pith or cork.

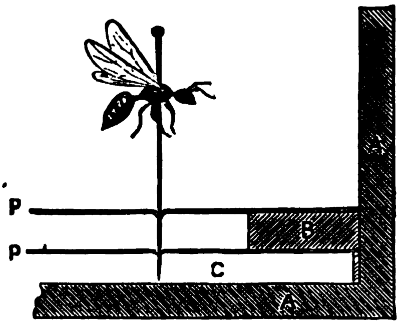

FIG. 167.—PAPER LINING FOR INSECT BOX: *A*, *A*, SIDE AND BOTTOM OF BOX; *B*, FRAME; *C*, OPEN SPACE; *P*, *P*, PAPER. (AFTER MORSE.)

Various substitutes have been used for cork. The compressed cork is usually of uneven texture; patent cork is a much better material. Many have used sheets of peat covered with paper, which is very soft, and for study collections it is handy, but is apt to produce too much dust. It is cheaper than cork. Pith of various plants has been recommenced. Corn pith can be readily obtained and if well dried can be used by the beginner for lining cheap boxes. A material called "Suberit" is being used by many collectors. Corrugated paper can also be used for temporary boxes. A substitute for cork is a soft thick paper, drawing or log paper, stretched on a frame that fits in the bottom of the box. If the paper is moistened slightly before being glued to the frame it will tighten in drying. Paper may be glued to both sides of the frame as in figure 167. The frame rests on a one-fourth inch ledge, leaving a little space between it and the bottom of the box.

Special mounts of insects.—The Denton brothers have invented a way of mounting insects known as Denton tablets. These are blocks of plaster of Paris with a depression for the body of the insect, and glass covers. The glass cover is hermetically sealed to the block by paper strips. These tablets can be purchased for a moderate price. What are known as Riker mounts are used to exhibit insects. There are pasteboard boxes, having tightly fitting covers with a glass top. The box is lightly filled with white cotton, the insect spread out on top of it, and the glass cover put down and fastened (pinned) or sealed with gummed paper. These boxes are made in various sizes, and can be procured from the dealers. They are not pest-proof, but insects may be kept a long time in them without any trouble. Flake naphthalene may be scattered in the lower layers of cotton to keep out pests.

ARRANGEMENT OF INSECTS.

Within the boxes or drawers insects are customarily arranged in vertical columns, the larger species in three or four rows, the smaller species in from six to eight rows. It is generally possible to adopt a uniform width for the insects of each family; four columns in a Schmitt box and six in a drawer are the usual number. Many entomologists make no marks to indicate the edge of the column; some use strips of colored paper; others make a pencil or ink mark; and Doctor Britton has suggested the use of a fine wire, bent down at each end. The specimens should be carefully pinned in to preserve the alignment of each row. Some prefer to arrange the specimens beginning with the larger ones and ending with the small forms; others put them in alphabetically; but the best way is to follow a catalogue or published list. Formerly four specimens were considered a "set" of the species; now, most collectors wish eight specimens, and collections in the museums usually run up to twenty-five or more. A large series enables one to present the variations and range of the species. Museums sometimes make a duplicate collection of the overflow from the regular series. It is desirable to leave some vacant space in each box for additional species. Where the sexes are separated, the males are kept in the first row and the females behind them. Each species in the collection should, if possible, be labeled with its generic and specific name. Some prefer to pin the label to the first specimen of each species, and this is suitable for most collections. Many entomologists prefer to have a small label with specific name pinned behind the series of each species and a larger label with the generic name in front of the first species of the genus. Others include also order, family, subfamily, and tribe labels, but an overlabeled collection detracts from the specimens. Blank labels are for sale by all dealers. One should not use a label larger than necessary to write legibly the name of the insect. Museums sometimes purchase two copies of the various catalogues and cut them up, fastening with short pins these printed labels behind each species.

Some collectors arrange valuable specimens, such as types of new species, differently from the regular collection. Mr. Ball and others keep the type-specimens in separate boxes, taking care to handle them as little as possible. Mr. Caudell puts up types of Orthoptera in Riker mounts, but this will hardly do for insects of any other order. Many entomologists send their types to some large museum. Several entomologists, who have sufficient means for the purpose, construct a small building of brick or stone to house their valuable collections.

PESTS IN COLLECTIONS.

After the entomologist has collected, pinned, spread, labeled, and arranged the specimens in the cabinet he is not permitted to keep them in peace. Certain other insects, mites, mold, grease, etc., make their appearance, and unfailing vigilance is the price of perfect specimens. Neglect to attend to a collection will surely invite its destruction. In some parts of the country these pests are not nearly as abundant or as destructive as in other portions. The most injurious insect pests are beetles of the families Dermestidæ, Bostrychidæ, Ptinidæ, and Tenebrionidæ.

The larvæ of the Dermestidæ are hairy creatures with short legs and often with tufts of hair at the ends of the body. They feed and breed all the year, except when it is too cold. They will feed on a great variety of substances, boring into and reducing them to a mass of fine dust. The forms most injurious belong to the genera *Dermestes*, *Trogoderma*, *Anthrenus*, *Attagenus*, and *Perimegatoma*. *Anthrenus verbasci* (*varius*) is the common pest in most collections in the northeastern part of the United States. *Trogoderma tarsale* is more abundant in the South and West. *Anthrenus scrophulariæ* is occasionally found in collections. Two species of *Attagenus*, *A. pellio*, and *A. megatoma*, sometimes attack insect collections, and *Dermestes lardarius* is also an occasional enemy. *Perimegatoma variegatum* is so far only found in collections in California. Recently a peculiar and remarkable dermestid has been found in some collections; it is *Thelydrias contractus*, better known as *Ignotus ænigmaticus*. The Chilean insect pest *Cryptorhopalum flavopictum* will doubtless some day be introduced into our collections. Of the Ptinidæ, one species, *Ptinus fur*, is sometimes found feeding in collections, and one Tenebrionid, *Tribolium ferrugineum*, a cosmopolitan beetle feeding on many kinds of stored foods, is found but rarely, most often on imported collections. One Bostrychid, *Dinoderus pusillus*, has been also taken a few times in insect collections. Of the Psocidæ, several species of wingless forms, principally *Troctes divinatorius*, often do much damage to pinned insects. The delicate specimens are especially subject to their attack. A few mites and a Tineid larva are sometimes injurious to dried insects. When in the field, ants sometimes get into the collecting box. If the box be soaked in oil of tar, the odor, which keeps for many years, will prevent the entrance of ants. In the South, ants of the genus *Monomorium* sometimes attack collections, getting into Schmitt boxes through the crack near the hinges.

Remedies.—Insects will get in where one would hardly suppose it possible, so that the collector should be extremely particular as to the tightness of boxes. There are two excellent methods of fighting insect enemies of insect collections. One is the use of carbon bisulphide to fumigate the boxes. A little poured into an infested box will destroy all living insects. A good plan is to put the open box into a larger box in which is placed a little of the carbon bisulphide. In this way one will not stain the paper of the insect box. Museums often have a large box especially prepared for fumigating specimens. A good way is to fumigate all specimens received before placing them in the cabinet. Carbon bisulphide is highly explosive, and should not be used near a light.

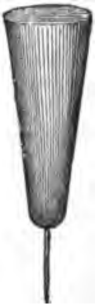

FIG. 168.—A NAPHTHALENE CONE.

The best repellent against insect attack is naphthalene. A good quality will not only keep out the insects, but will hinder the development of their larvæ and eggs. The best form in which to use this material is that of the crystals, known as "flake naphthalene." The dealers supply cones of naphthalene (fig. 168), with a pin, which may be fastened in the corners of the box. It is easy, however, to make these for oneself by utilizing the common moth balls. A heated pin is thrust head-first into a moth ball. As it cools it is fastened solidly into the ball. The cones and moth balls in evaporating leave a dirty, blackish deposit. One may prevent this from soiling the paper of the box by pushing a small paper pill box up the pin under the cone before pinning the cone into the box. Another way is to wrap the moth ball in a bit of Swiss netting and pin this in the corner of the box. Some collectors use creosote to kill pests. A wad of cotton soaked in creosote is placed in a small metal box or thimble, which is fastened or pinned in the corner of the box. The English often use carbolic acid and sometimes oil of lavender for protecting their collections. A piece of camphor is dissolved in the carbolic acid, and then this is poured on a small sponge which is pinned to the cover of the box.

Mold.—If a collection is stored in a damp place, or if pasteboard boxes are used in a moist climate, the specimens are apt to mold. Carbolic acid is the best remedy. A little poured into a box, or, better, on a sponge pinned in a pill box in the corner, will prevent mold. Moldy specimens can be cleaned with carbolic acid applied with a fine camel's-hair brush.

Verdigris.—The acid juices in the bodies of certain insects have an affinity for pin metal, so that when these specimens are mounted on bright pins a green substance known as verdigris will accumulate about the pin, finally corroding it so that it will easily break. Black or japanned and silvered pins do not verdigris, and therefore are to be preferred for many insects. In collections there are often specimens which have been pinned with a white pin and later have verdigrised. If it is desired to save these they should be remounted with black pins. This may be done by putting the insect for a day or two into the relaxing jar; then pull out the pin and place the insect in ether or gasoline, which will dissolve the grease and verdigris; then clean and put in a new pin. It is claimed by some that ammonia will dissolve and remove the verdigris. Aquatic insects and those whose larvæ live in wood are particularly subject to verdigris. Insects saturated with salt water are also apt to corrode the common bright pins.

Grease.—Some insects have so much fat in their bodies or it is in such a condition that in drying it spreads over the insect and out on the wings. This is a common trouble with many moths. They can be readily cleaned with gasoline or ether. Pin the specimen tightly to a piece of cork which is fastened in a deep vessel, then fill up the vessel slowly and carefully with gasoline until the specimen is covered. It may be left for two or three days, and when taken out and dried in a place where there is no dust it will become as fresh and clean as a perfect specimen. If only the abdomen is greasy this may be broken off and put into the gasoline, and later glued to the thorax. Sometimes it will be necessary to keep badly greased specimens in the ether or gasoline a longer time, or to change to fresh gasoline at the end of two or three days.

The Denton brothers put papered Lepidoptera, papers and all, into the gasoline and leave for two weeks; then take out and dry, without removing the insects from the papers. When dry they are fluffy and fresh as though never wet. Of course gasoline should not be used when near a light. Collections of insects should be looked over twice a year for pests, at least in a region where pests are at all common. The dates will vary somewhat according to latitude, but the best times will be in March or April in the spring, and again late in August or early September. No one who really loves the specimens he has collected and studied will fail to take proper care of them.

REARING INSECTS.

It has already been indicated that the best way to secure perfect specimens of Lepidoptera is by rearing them from the immature stages. Many entomologists, however, soon become interested in the life histories of insects, and find the collecting and rearing of the larvæ as attractive as even the study of the minute details of structure in the adult insect. In no branch of natural history are life histories more readily studied than in insects. The ease with which the caterpillars of many butterflies and moths may be kept in captivity make them the most suitable subjects for experimentation in many lines of biological inquiry. As in collecting so in rearing, the simplest apparatus is usually the best. However, different groups respond better to different treatment, and there are many wrinkles in the handling of living material that can only be obtained by long practice.

For many caterpillars almost any sort of a wooden box, with some sand in the bottom and covered with mosquito netting, will make a suitable rearing cage. Branches of the food plant can be put in each day, the moist sand keeping it fresh until the next day. Tight boxes may be used, provided they are kept clean. For small insects glass jars or jelly glasses are very useful, and many species can be reared in ordinary glass test tubes, plugging the top with a bit of cotton. A pot cage is readily made by taking a flower pot with soil in which there is inserted the plant, and over the plant an ordinary lamp chimney, pressing it down well into the soil and covering the top with netting. (See fig. 169.) By pouring water into the saucer of the flowerpot the plant may be kept moist. Mr. Foster has modified the plan slightly by using a tin can of earth containing a bottle of water in the center, the top of the bottle even with the top of the soil. The plant or branch is placed in the bottle and about its base a wad of cotton, so the larva can not fall into the water. Over the plant is placed a glass Welsbach gas chimney covered with netting.

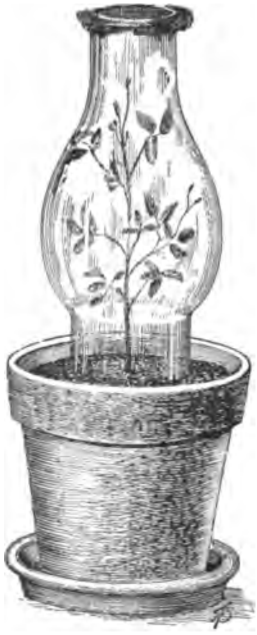

FIG. 169.—A LAMP CHIMNEY CAGE.

A more elaborate breeding cage utilized by Doctor Riley is shown in the illustration (fig. 170). The box is of wood, with a removable top covered with wire netting. The sides are of glass, or may also be of wire netting. One side is made into a door. The cage can be placed on a zinc base made as in figure 171. This cage may be made any size. A convenient one is 12 inches square and 18 inches high. The inner box of the metal vase has holes in it so that water put in the outer box will moisten the sand in the inner box. The branch or plant may be put in the top "*d*" with a wad of cotton to hold it in place. Many species will breed in almost any situation, but with others one must be particular about fresh food, sunlight, and ventilation. The amount of moisture necessary for the proper development and expansion of the wings varies, and one must learn this by experience. A wet sponge or blotting paper will give a supply of moisture. One should be careful not to put too much food in the cage at one time, as it may mold and injure the larva. Some larvæ feed better in a darkened place. This may be simulated by wrapping the jelly glass or other cage with a piece of black muslin. Other larvæ will feed only at night, and should have some soil or litter in the bottom of the box under which they may conceal themselves during the day. After once starting a larva on a certain food plant it is not well to change it, although it can sometimes be done with safety, and seems to be preferred by a few caterpillars.

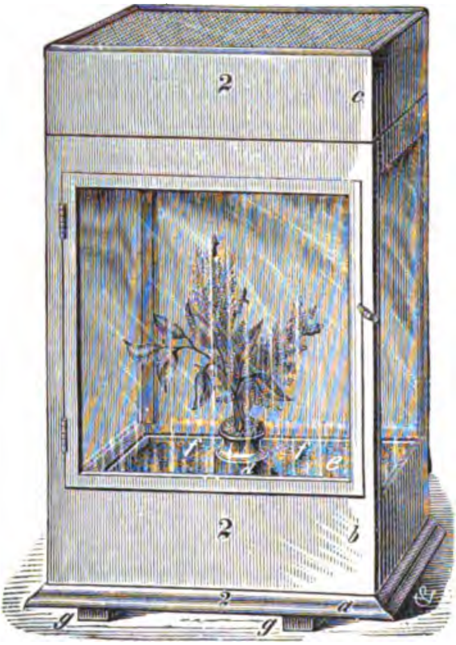

FIG. 170.—AN INSECT BREEDING-CAGE, OR VIVARIUM.

Sometimes it is impossible to obtain the ordinary food plants of the larvæ, and one must resort to a substitute food plant. Often an allied plant will give satisfactory results. If, for example, a larva should feed on apple, and this can not be had, one may discover that an allied larva feeds on walnut, or both apple and walnut; then walnut may be the substitute for apple in the first case. There are a

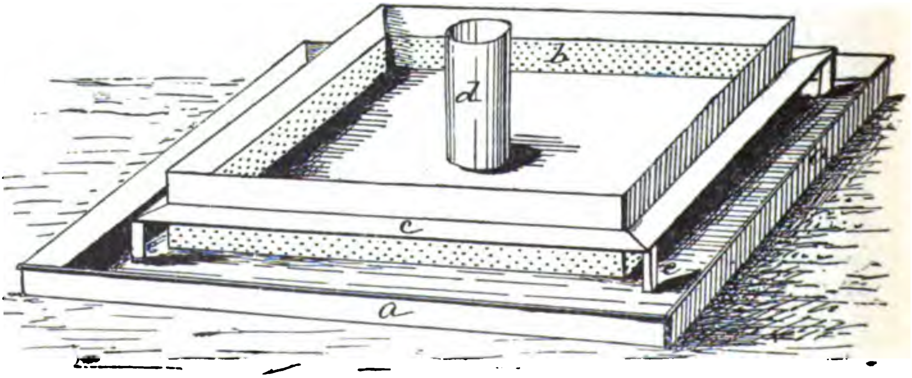

FIG. 171.—THE IMPROVED BASE FOR BREEDING-CAGE.

number of plants that are eaten generally by a large number of caterpillars. Polygonum, for example, is noted as a food plant for many Geometridæ; lettuce is eaten by many Noctuidæ; apple by many Notodontidæ, etc. Buds are sometimes split and fed to larvæ that issue before the leaves are out.

In some cases it is better to put a cage over an outdoor plant. A headless keg covered with gauze makes a good outdoor cage. Two or three pieces of willow may be bent over a plant, the ends stuck in the ground, and this frame covered with gauze or netting. Moths and butterflies may sometimes be induced to oviposit in such a cage when they would not in the laboratory. Mr. Fletcher succeeded in getting a few eggs from reluctant females by gently pressing the tip of the abdomen until one or two eggs were deposited. This may be done with specimens that have just died. Outdoor cages are used by the cotton boll weevil investigators and at the gipsy moth laboratory. They are light frames covered with wire netting, and tall enough for a person to stand in them. Some styles are described in Technical Bulletin No. 12, part 6, Bureau of Entomology, U. S. Department of Agriculture. Others may be devised to suit special circumstances by any ingenious mind. One may find it advantageous to tie a piece of netting over a branch or twig on a tree or bush outdoors. This is especially useful in getting the insects that are developing within the seeds of plants.

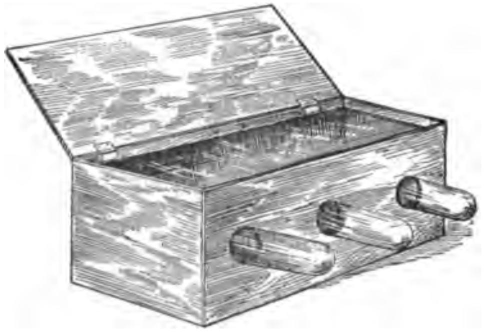

FIG. 172.—A BREEDING-CAGE FOR PARASITES.

A breeding cage (fig. 172) used by the California Board of Horticulture and by the cotton boll weevil investigators is a wooden box 10 or 12 inches long and 6 to 8 inches wide and of about the same depth. This box is fitted with an inner cover of glass and an outer cover of wood. One can therefore examine the material without permitting the escape of the insects. In one side of the cage several holes are bored and a glass tube fitted into each. The insects will be attracted by the light and come out into the tubes. The tubes can be quickly removed, the hole stopped with cotton, and the insects dumped into a cyanide bottle. For insects that pupate in the soil a layer of sand may be put into the bottom of this box.

Professor Comstock has devised a root cage, as shown in figure 173, in which to rear and study hypogean or underground insects. The cage consists of wooden ends with glass sides. It is filled with soil, and the plants send their roots down near the glass. The glass sides are covered with a sheet of tin or zinc which excludes the light. This cage may be let down into a hole in the soil and so kept at about the normal temperature of the soil. A large number of wood-boring insects may be reared by collecting dying wood and fallen twigs in the autumn and carrying them into a room. In the spring the insects will issue and fly to the window. Similarly galls, acorns, and seeds of various kinds may be placed in jars to rear the insects.

Mr. Elliott, who raised many pupæ, kept them in a pupa box made as follows: A box about 20 by 16, and 8 inches deep, with a bottom of coarse wire cloth placed about 2 inches from the bottom, is divided into four compartments by thin wooden partitions. Over the wire cloth is placed a thick layer of baked sphagnum moss which has been pulled into fine bits. The pupæ are laid on this floor of moss and covered with a thick layer of moss prepared in the same manner as that beneath. The box is covered by a glass plate. In the summer and autumn this box may be kept over a pan of water, but in the winter time it should be left in a cool room or even out of doors where it will not be injured nor become too wet. Pupæ should not be kept in a heated room. They are apt to dry out or else the imago will not properly expand its wings.

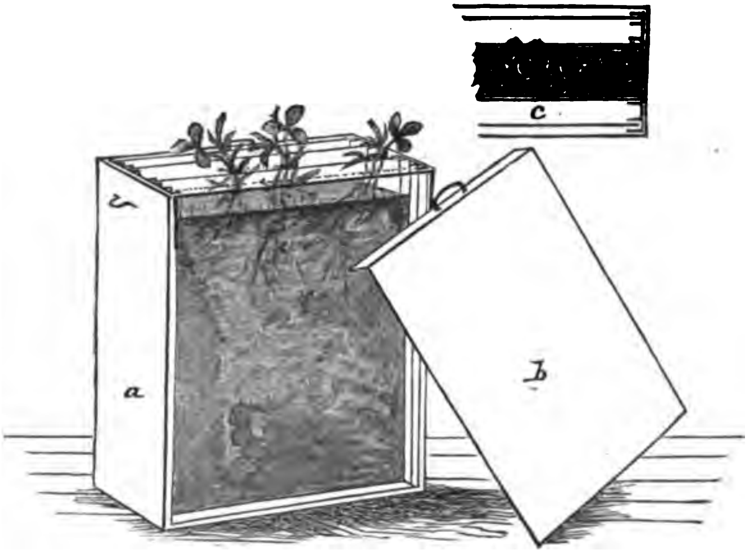

FIG. 173.—A ROOT CAGE, FOR REARING INSECTS WHICH LIVE UNDERGROUND. *a*, FRAME WITH SLIDE REMOVED; *b*, MOVABLE SLIDE; *c*, TOP VIEW.

Mr. Burke made a neat cage for rearing some insects infesting bark by knocking off the bottom of a baking-powder can, cutting the sides into narrow strips, and tacking these to the tree over the spot where the insect was feeding. This cage is shown in figure 174.

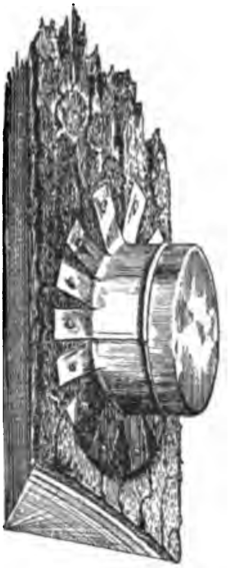
FIG. 174.—A CAGE FOR REARING BARK-INFESTING INSECTS, FASTENED TO TREE.

It is very instructive to keep ants in an artificial nest. A simple one may be made by taking a piece of 1½-inch board, say 12 inches square, and make near the edge a channel three-fourths inch deep and 1 inch wide, and put in the center two panes of glass 8 inches square, and between them a thin layer of soil or comminuted wood. Cover the top glass with a piece of tin. The channels around the edge of the bottom board should be nearly filled with water. Ants placed between the glass will excavate tunnels, and may be kept a long while. A better nest (fig. 175) for studying the habits of ants was prepared by Miss Fielde, and is as follows: It is made of panes of glass glued together by Le Page's liquid glue. A large square pane is used for the bottom. The wall and partitions are narrow strips of glass laid flat. Two strips of "double thick" glass make it the right height. An aperture at "*a*" is left, but plugged up with cotton except when one wishes to transfer the ants to another nest. On the top of each wall and partition is a narrow strip of coarse toweling. It is glued to the top of the glass and then the free edge turned back. The partitions and walls are then less than one-half inch high. Two panes of glass are used for the roof, so that one can be removed at a time. These roof panes are just laid on and not fastened. Over each is a piece of black blotting paper to darken the rooms. The outside walls are also painted black. In one room is a thin, flat piece of wet sponge; this is to furnish drink for the ants and moisture for the rooms. If the ants have many cocoons, a piece of dry cloth should replace the sponge, as ants keep their pupæ in dry situations, while the larvæ need moisture. The whole nest can be placed on a sheet of white blotting

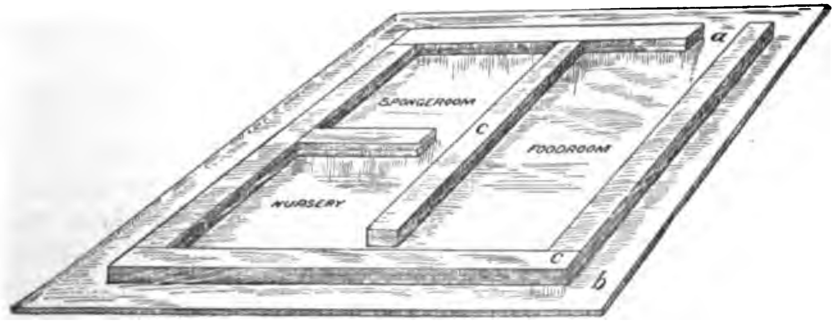

FIG. 175.—THE FIELDE ANT NEST: *a*, *b*, GLASS BASE; *c*, *c*, PARTITIONS.

paper. Food is placed in one room. The other room is kept for the nursery. More elaborate nests can be made on this same plan, with more rooms and with some slender partitions near the larger walls to simulate ant runways. The roof may be fastened down and the nest carried about, or several nests may be fitted into a case especially made to carry them.

Doctor Barth has kept ants in artificial nests made by placing a glass jar or cylinder inside another glass jar of slightly greater diameter, the space between the two filled with soil, or wood dust, in which the ants can tunnel and form their nests. The inner jar is shorter than the outer, and the inner space or well is used as a food chamber. A stick leading from the bottom of the well to the top of the inner jar permits the ants to go from the nest to well and back. A net of wire can be placed over the top of the outer jar to prevent the escape of the ants. A cylinder of dark paper can be slipped over the outer jar to darken the ant burrows.

To rear the predaceous beetles, like *Cychrus* and *Carabus*, one should place them in wooden boxes with fine-mesh wire covering. In the bottom of the box put about 2 inches of earth, moss, and decayed wood. On the top of this sprinkle the ground with water every two days. The *Cychrus* feeds on snails. Other forms will eat meat, or the maggots on fly-blown meat. When eggs are observed in the cage, remove the beetles and keep the cage in a dark, cool place. When the larvæ are a few days old, each should be kept in a separate box. The principal enemies of breeding insects are mold and mites. The mold must be prevented by using no more moisture than necessary and by ventilation. The mites, often of the genus *Pediculoides*, are kept out by thorough cleanliness and washing the cages and jars in a solution of carbolic acid and later in hot water.

Rearing aquatic insects is often more difficult than rearing terrestrial species. In some cases one can take a large Mason fruit jar, or purchase a glass jar from the dealers, and put some sand and pebbles in the bottom, and with a few fresh-water plants he can keep a number of species for some time. The main difficulty is in the water becoming stale. All decaying matter and uneaten food should be removed with a pipette or long glass tube. It does not pay to try to keep too many kinds of insects in the same aquarium. Some of the dealers sell flattened jars, 2 or 3 inches thick and 6 or 8 inches wide, and a foot or more high, which are very suitable for aquaria. Any large predaceous species will, of course, soon free an aquarium of its other inhabitants. Where one has a flow of water available, he can arrange a siphon outlet and insure fresh water all the time. Many aquatic larvæ will not develop properly unless in running water. If near a stream, one can arrange a cage of wire screening or Swiss netting over a stone or plant in the water on which are the larvæ of the desired insects.

Doctor Needham has used for rearing aquatic insects a wire cage shown in figure 176. It is a cylinder of galvanized wire screen, open at both ends, with a loose screen cover. The cylinder may be pushed down over the plant or rock deeply enough into the bottom so that the larvæ or nymphs can not escape, sometimes 2 or 3 inches into the mud.

A water cage or aquarium can be made by cementing together panes of glass. Make a bottom of one piece of wood, with a groove around the edge. Set the panes of glass in the groove and bind their edges where they come together with strips of muslin glued on the outside, and place a narrow, oblong strip of glass inside across each corner. Fill this space and also the bottom groove with a cement made as follows: White sand, 1 part; plaster of Paris, 1 part; litharge, 1 part; and powdered resin, one-third part. Make into a thick paste with boiled linseed oil. Let the cement harden for several days before putting the water into the aquarium.

In rearing mosquitoes it has been found necessary to isolate the larvæ. Doctor Dyar does this as follows: When a batch of larvæ is gathered in a vessel from a pool a number of flat-bottom vials (8-dram) are half filled with water from the same pool and a little dirt or mud from the bottom of the pool placed in the bottom of each vial. Then with a pipette each larva is transferred to a vial, one larvæ only in each vial, and the top plugged with cotton. When the larva changes to a pupa the last larval skin is removed and put into a tiny vial of alcohol with a little glycerin. This vial is then inserted in the cotton, plugging the larger vial until the mosquito emerges from the pupa. Then both mosquito and larval skin are given the same number. One is thereby certain that the skin and adult are of the same species. The adult mosquito should not be killed as soon as it issues, but allowed a day or so to chitinize and attain its colors. The vials with larval skins may be stored or canned in larger bottles until one desires to study them, when they should be mounted on slides. Anopheles mosquitoes need more surface than is afforded by a small vial and can be reared in open saucers.

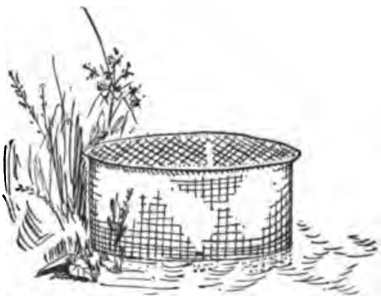
FIG. 176.—THE NEEDHAM AQUATIC CAGE.

In rearing caddiceflies, Vorhies has found that for those that inhabit standing waters ordinary crystallization dishes, 6 or 8 inches in diameter, provided with a screen cover, are suitable receptacles. Whenever possible one should try to obtain the pupæ, as results are more certain, and in several families the larval exuvia is retained in the pupal case, and can be compared with larvæ collected at the same place. With other species occurring in running water it will be necessary to supply them with running water, or else to place a small cage over a larva in a stream and await its development.

SHIPPING INSECTS.

Entomologists increase their collections largely by exchange. A collector in one part of the country writing to one in another tells him what he wants and what he has to offer in exchange. These lists are called "desiderata" and "offerta." Sometimes, in exchanging, collectors use the numbers of some recognized catalogue instead of writing out the names. It is customary in sending to number the specimens and in the letter give the list of numbers with the names. In exchanging, one should endeavor to send as good specimens as possible, neatly mounted and labeled and carefully packed in secure boxes. Most insects are fragile, and one must use great care in packing them. The specimens should be securely pinned in the box, but not hammered down. If there are any with large bodies or long, slender abdomens, these parts should be braced by pins placed crosswise. The top of the box should be so fastened that it can not be easily mashed in. A strip of wood is sometimes fastened on the inside at the top of the box to give further support to the cover. The box should, if sent by mail, be wrapped, not too tightly, in cotton or excelsior about 1 inch thick around it. However, it is better to put this box into a larger box, with 1 inch space or more each side, and this is filled, but not too tightly, with cotton or excelsior.

Sometimes a little cotton is placed around the outside of the outer box. Most Coleoptera, Hemiptera, and Hymenoptera are not very fragile, and a good wrapping of cotton or excelsior is all that is necessary. With Lepidoptera, Neuroptera, and Diptera one can not be too particular in packing. The Lepidoptera and Neuroptera are more safely shipped in papers in a tin or wooden box; then there is no danger of breakage.

If one has a box of specimens as large as an ordinary cigar box it had better be sent by express, especially if it contains fragile insects. There should be at least 2 or 3 inches space between the cigar box and the outer box; the latter should be a stout one and the space lightly filled with excelsior; never try to cram in all the excelsior you can, but only enough to keep the box securely in its place. It is much better to screw the top on than to nail it, as the jar in nailing may break or loosen something. The handiest way to ship by express is to use a flat half-bushel basket, packing it with excelsior and covering the top with stiff manila paper. The basket can be tied across each end, lengthwise through the middle, and then around the sides. The handle should be left on, and the address, as well as the name of the sender, written plainly on the cover, and the word "care," in large letters, will do no harm. In sending insects abroad by mail the package should be registered; if by express, use a box with cover tied with plenty of strong twine, so that the custom officers can examine without hammering or breaking the cover. Some use a glass-top box for the inside box. In sending by mail, never pack a small box on top of a larger one; it will break in the larger box.

In shipping alcoholic material, one vial may be placed in a wooden or pasteboard mailing tube (fig. 177) manufactured for such purposes. These are often lined with cork and have a screw top. The cotton packing around the vial should not be crowded in too tightly. When many vials are to be sent, each should be wrapped in a bit of soft paper and then all packed in cotton in a stout wooden or tin box; some cotton wrapped outside these boxes will prevent breakage. A bit of cotton placed in the vial with specimens will wad up and shake back and forth in traveling, and so destroy fragile specimens.

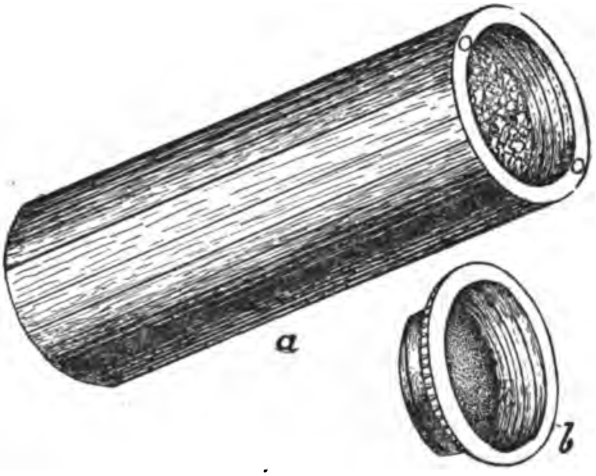

FIG. 177.—A MAILING-TUBE: *a*, TUBE; *b*, COVER.

Never send insects in a letter; it can be done over and over again, but it is risking the specimens. In sending living specimens use a tight box and do not punch holes in it; the insect will not suffocate. Sometimes it is necessary to put food in with the living insect, as a caterpillar sent for a considerable distance, but usually anything inserted with the specimens will simply help to kill them. The pupæ may be shipped in dry moss. Postal regulations affecting natural-history specimens vary from time to time; usually such specimens are sent as fourth class, 1 cent an ounce. Many foreign countries have a parcels-post regulation, which enables one to send large packages cheaply. When shipping papered specimens a long distance, a little flaked naphthalene sprinkled over them, or, better, in the packing, may help to keep out insect enemies; if for a long sea journey, a little carbolic acid poured on the outside of the box will prevent mold. It should be remembered that insects imported from abroad are subject to customs duty of 10 per cent on unmounted and 20 per cent on mounted specimens.

Many of the leading entomologists in the United States are willing to name specimens sent to them for that purpose, provided, of course, they are permitted to keep any specimens that are new to their collection. Most of these specialists do this work in their leisure moments, and the sender should, therefore, do all he can to lighten the labor of identification. The specimens should be sorted in groups in the boxes as far as possible, and each specimen or each species should have a number. In sending Lepidoptera or other insects with large spread of wings they may be "shingled," that is, the specimens may be pinned obliquely backward, so that the wings overlap the specimens in front and to the side. This saves much space. Many collectors put a thin layer of cotton over the cork of a shipping box; this sometimes saves legs and abdomens.

COLLECTING ARACHNIDA AND MYRIOPODA.

Spiders (fig. 178), mites, thousand-legs, etc., are not insects, but belong to several related groups. The spiders and mites are Arachnida, distinguished by having eight legs and only two parts to the body—the front part, known as the cephalothorax and bearing the legs, and the hind part, called the abdomen. The true spiders, or Araneida, have no segmentation to the abdomen, which is attached to the cephalothorax by a slender pedicel. This cephalothorax in front has eight simple eyes, and below in front is a pair of stout jaws, mandibles or cheliceræ. The palpi are short, leglike appendages near the mandibles. At the tip of the abdomen are four or six little processes, close together, the spinnerets. From these spinnerets issues the silken thread that spiders use to make their webs, cocoons, etc.

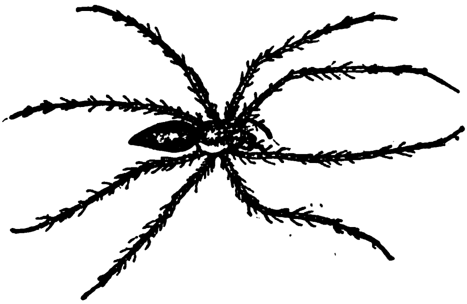

FIG. 178.—A SPIDER, PEUCETIA VIRIDANS. (AFTER COMSTOCK.)

The majority of spiders do not make a web, and live by hunting for their prey. The orb-weaving spiders (Epeiridæ) (fig. 179) make a geometrical or orb web, like spokes of a wheel, with cross threads; and there wait, head down, on the center of this web until some insect falls into it. The tarantulas (Theraphosidæ) are the largest spiders and have very hairy bodies and legs. Many of them live in holes, mostly in the southern part of the United States. Sometimes they are found in the North in bunches of bananas.

The daddy-long-legs, harvest-men, or Phalangida (fig. 180) have the two parts of the body broadly joined together, so there is no pedicel. The abdomen shows the segments more or less closely united. The legs are longer than usual in spiders, and there are only two simple eyes situated on a little tubercle or eye-eminence on the front part of the cephalothorax. They have no spinnerets. The scorpions, or Scorpionida (fig. 181), have the body elongate, plainly segmented, and behind narrowed to form a tail or cauda, which ends in a vesicle with a sting. The abdomen is broadly united to the cephalothorax, and the palpi are long and end in two pairs of claws. There are two or three simple eyes on each side, and a pair in front on the cephalothorax. On the under side of the body, near the hind pair of legs, is a pair of appendages called "combs." The book or false-scorpions (pseudo-scorpions) (Chelonethi) (fig. 182) are diminutive editions of the scorpions but without a tail. They have only one or two eyes on each side of the head and no "combs."

The mites and ticks, or Acarina, have no division of the body into parts or segments, or it is only faintly indicated. The mouth-parts are usually close together and form a beak or rostrum. They are nearly all of very small size and of very diverse shapes and habits.

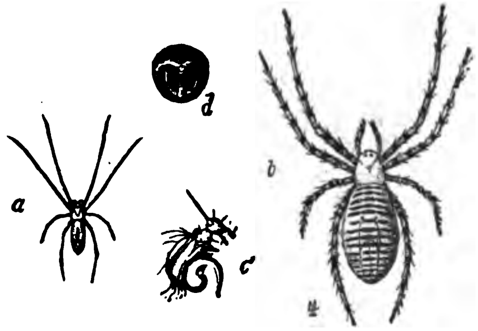

Fig. 179.—An orb-weaver, Argiope trifasciata: *a*, male; *b*, female; *c* and *d*, enlarged parts.

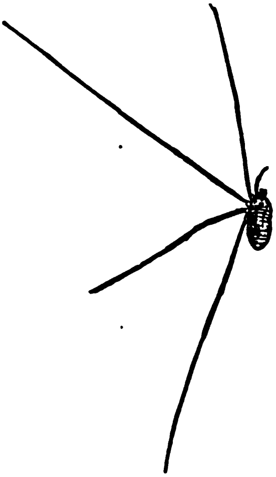

Fig. 180.—A harvest-man, Liobunum ventricosum. (From Packard.)

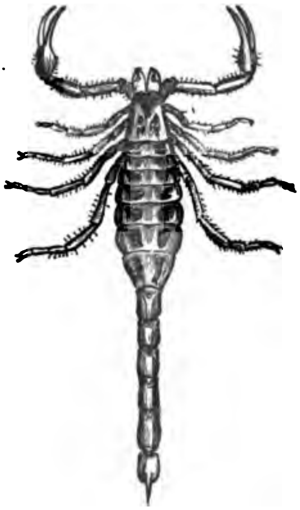

Fig. 181.—A true scorpion, Centrurus carolinianus. (From Packard.)

Many are parasitic on man or other animals. The red spiders (Tetranychidæ) (fig. 183) are soft-bodied forms, feeding on the foliage of trees and plants, and they spin a thread wherever they go. The harvest mites (Trombidiidæ) are large, red mites sometimes seen wandering in the springtime. Their larvæ are called "red bugs," and attack people as well as animals. The cheese mites (Tyroglyphidæ) (fig. 184) feed on stored foods, cheese, flour, seeds, dried fruits, and the roots of plants. They are soft-bodied, and of a pale whitish color. The ticks (Ixodoidea) are larger than most mites, and with a tough, leathery skin. They have a breathing pore in a granulated plate just above the hind legs. The cattle tick (*Margaropus annulatus*) (fig. 185) is the carrier of Texas fever, and the Rocky Mountain tick (*Dermacentor venustus*) is the disseminator of spotted fever. The scab or itch mites (Sarcoptidæ) are small, soft-bodied forms that burrow in the skin of various animals, including man, thereby causing scabies, a disgusting disease. The Eriophyidæ, or gall-mites (fig. 186), are so small

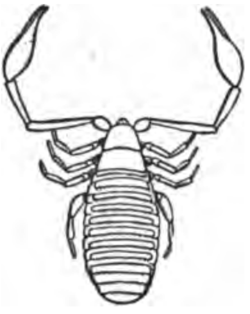
FIG. 182.—A FALSE SCORPION, CHELIFER CANCROIDES. (FROM PACKARD.)

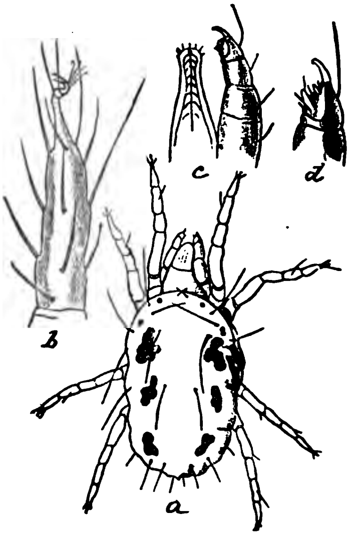

FIG. 183.—THE SIX-SPOTTED MITE OF THE ORANGE, TETRANYCHUS 6-MACULATUS: *a*, FROM ABOVE; *b*, TARSUS; *c*, ROSTRUM AND PALPUS; *d*, TIP OF PALPUS. *a*, GREATLY ENLARGED; *b*, *c*, MORE ENLARGED; *d*, STILL MORE ENLARGED.

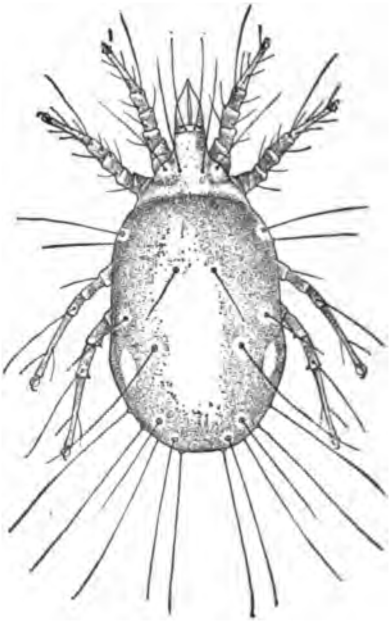
FIG. 184.—A CHEESE MITE, TYROGLYPHUS.

one can hardly see them without a glass. They make galls on the leaves of trees and shrubs. These galls have an opening which distinguishes them from most insect galls, excepting those of the Homoptera.

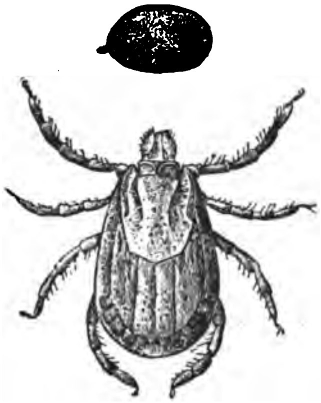
FIG. 185.—THE CATTLE TICK, MARGAROPUS ANNULATUS. (AFTER PACKARD.)

There are three other smaller groups of Arachnida. The Solpugidæ, or ringed spiders, sometimes called vinagarettes or vinagarones, have the abdomen segmented, the palpi are simple, and the mandibles are very large and prominent. The Phrynida are flat creatures with segmented abdomen connected to the cephalothorax by a slender pedicel. The palpi are spiny, and the first pair of legs very long and fine. The whip-tailed scorpions (Thelyphonida) have a segmented abdomen with a fine filament at the tip. Their palpi are very heavy and spiny. They are also called vinagarones and mule-killers, but are not poisonous. Most of the Arachnida are predaceous or parasitic on animals, but quite a number of mites are phytophagous. In most of our spiders the jaws are so small and weak that they can not pierce a person's skin, and those that can do so have not a poison sufficiently strong to cause much pain. The tarantulas of the West and South should not be handled, but the cases of dangerous bites from these creatures are extremely few. The ticks attach themselves to people, and sometimes their bite causes much pain, and one kind carries a disease. The red bugs, the young of harvest mites, are an intolerable nuisance in many parts of the South. The sting of our scorpions is rarely more severe than that of a wasp or hornet.

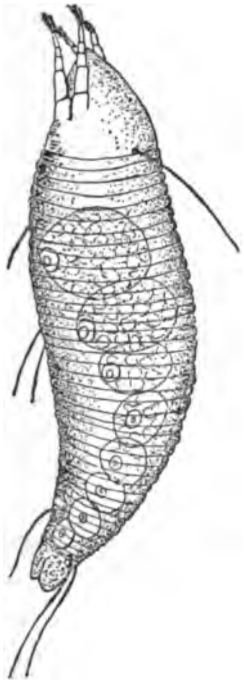
FIG. 186.—ONE OF THE GALL-MITES, ERIOPHYES.

The Myriopoda include two very distinct groups which really are not related to each other. One, the centipedes or Chilopoda, are like long wingless insects with a pair of legs to each segment of the body. The house centipede, *Scutigera* (*Cermatia*) *forceps* (fig. 187), is an example of this group. Its bite is often quite severe. Its poison comes from a large pair of jaws under the head, which is developed from the second pair of legs. They occur under leaves and stones, or rotten wood, etc. The millipedes, or Diplopoda (fig. 188), are very remote from insects. They have a hard, round, or flattened body of many rings, and each ring bears two pairs of legs. Their mouth-parts are weak, and they feed on vegetation or decaying matter. None of them can bite.

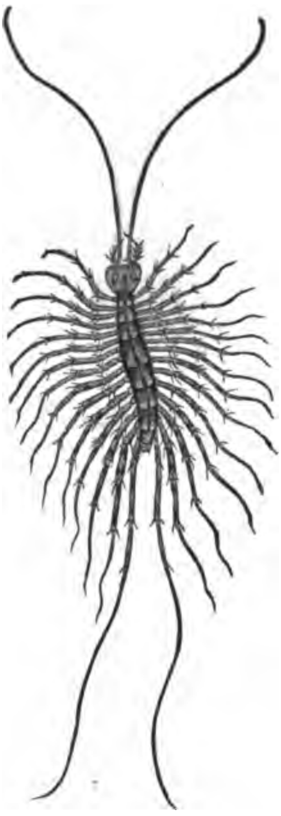

FIG. 187.—THE HOUSE CENTIPEDE, SCUTIGERA FORCEPS.

Most of the directions given for collecting insects apply to these groups. They are treated as alcoholic insects, but not so much apparatus is needed. A net is useful; a fine forceps is necessary, and a sieve net is very handy to get the small forms. All of these should be collected in vials of alcohol of about 60 per cent and later put in 75 or 80 per cent alcohol, with a little glycerin. The mites can be obtained by sifting leaves and moss, and under boards, in fungi, and on foliage. The egg sacs or cocoons of spiders can be collected in pill boxes. In collecting spiders one should learn to distinguish the adults from the young. The mature male has the tip of the palpi developed into a complicated accessory genital apparatus. The mature female has the vulva or genital opening exposed at the base of the venter of the abdomen. Spiders not having either of these two characters are immature. It is useful to collect the immature stages of spiders, but if one does not know the difference he is apt to gather a great number of young specimens. When one finds a spider in the young condition he may be able, by visiting the spot later, to find some adult specimens.

Most Arachnids and Myriopods should be kept in corked vials of alcohol with a little glycerine, just as alcoholic insects. Empty cigar boxes or Marx trays, made for a double row of vials, are suitable for arranging collections. The labels should always be inside of the bottles. Many mites are better when mounted in balsam or glycerin on slides. This is done as for mounting small insects. Many of these should be killed in hot water or acetic acid. The slides may be kept as those of insects.

FIG. 188.—A MILLIPEDE, CAMBALA ANNULATA.

COLLECTIONS OF INSECTS.

It will be of interest to the collector to know where some of the larger public collections of insects are kept. The principal public museums of the country containing important entomological collections are the U. S. National Museum, Washington, D. C.; the Museum of Comparative Zoology, Cambridge, Mass.; the Academy of Natural Sciences, Logan Square, Philadelphia, Pa.; the American Museum of Natural History, Central Park West, New York, N. Y.; the Carnegie Museum, Pittsburg, Pa.; the Museum of the Brooklyn Institute, Eastern Parkway, Brooklyn, N. Y.; the Field Museum of Natural History, Chicago, Ill.; the California Academy of Sciences, San Francisco, Cal.; the Boston Society of Natural History, Berkeley street, Boston, Mass.; and the Milwaukee Public Museum, Milwaukee, Wis. Besides these there are large collections in many of the universities and colleges, such as Cornell University, University of Kansas, University of Illinois, Rutgers College, New York State Museum at Albany, the Massachusetts Agricultural College, Ohio State University, University of Michigan, Colorado Agricultural College, University of Nebraska, Stanford University, University of California, etc. There is a directory of entomologists published by the American Entomological Society, Box 1577, Philadelphia, Pa.

PERIODICALS AND DEALERS.

The entomological periodicals of the country are as follows: Transactions of the American Entomological Society, American Entomological Society, Box 1577, Philadelphia, Pa.; Proceedings of the Entomological Society of Washington, Department of Agriculture, Washington, D. C.; the Canadian Entomologist, Entomological Society of Ontario, Guelph, Ontario, Canada; Psyche, Cambridge Entomological Club, Boston Society of Natural History, Berkeley street, Boston, Mass.; Entomological News, Academy of Natural Sciences, Logan Square, Philadelphia, Pa.; Journal of the New York Entomological Society, W. T. Davis, 46 Stuyvesant place, New Brighton, Staten Island, N. Y.; Annals of the Entomological Society of America, H. Osborn, Ohio State University, Columbus, Ohio; Journal of Economic Entomology, E. D. Sanderson, Durham, N. H. Many entomological papers are published in journals on general natural history and by the Bureau of Entomology, U. S. Department of Agriculture, and in the Proceedings of the U. S. National Museum.

The dealers in entomological supplies are: The Kny-Scheerer Company, 404 West Twenty-seventh street, New York, N. Y.; the American Entomological Company, 55 Stuyvesant avenue, Brooklyn, N. Y.; M. Abbott Frazer, 93 Sudbury street, Boston, Mass.; A. Smith

& Sons, 269 Pearl street, New York, N. Y.; Charles C. Riedy, 432 Montgomery street, San Francisco, Cal.; Bausch & Lomb Optical Company, 154 Sutter street, San Francisco, Cal.; Thiebaut Brothers (boxes), 2122–23, Lombard street, San Francisco, Cal.; the Simplex Net Company (nets), Ithaca, N. Y.; Queen & Co. (microscopes, lenses, etc.), 1010 Chestnut street, Philadelphia, Pa.; Bausch & Lomb Optical Co. (microscopes, lenses, etc.), Rochester, N. Y.; the Spencer Lens Company (microscopes, lenses, etc.), Buffalo, N. Y.; the Wiegner Printery (labels), 2234 North Twenty-ninth street, Philadelphia, Pa.; C. V. Blackburn (labels), 32 Chestnut street, Stoneham, Mass., and the Entomological Society of Ontario, Guelph, Canada.

OBTAINING AND KEEPING TRACK OF LITERATURE.

Although some of the books treating of insects can be purchased through the regular book trade, the larger number can only be secured through dealers in second-hand books. Many of these dealers advertise in the various entomological journals. Various societies frequently have for sale reprints of articles published in their proceedings. Such are the American Entomological Society, Philadelphia, the Entomological Society of Washington, the New York Entomological Society, etc. Some of these issue lists of the papers they have on sale. The various foreign dealers in second-hand books issue catalogues, which are sent free on request. It is cheaper to buy of these dealers directly than through an agency.

Owing to the great number of journals containing articles on entomology, it is often difficult to keep track of the literature on any particular subject. The Entomologische Litteraturblätter, published monthly by R. Friedländer & Sohn, Karlstrasse 11, Berlin, N. W. 6, Germany, at 25 cents a year, contains the titles of the greater number of articles published on insects. The Bulletin de la Société Entomologique de France and the Zeitschrift für Wissenschaftliche Insektenbiologie also contain lists of current literature. The Zoologischer Anzeiger publishes a nearly complete list of the literature on all zoology. The Zoological Record, published each year by the Zoological Society of London, contains practically all of the literature. The volumes are usually a year or more behindhand, and are rather expensive. The Concilium Bibliographicum at Zurich, Switzerland, issues references on cards. A list of works of value in studying North American insects is published by the Bureau of Entomology, U. S. Department of Agriculture, and can be obtained on request.

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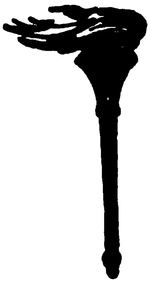

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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
Bulletin 68

A MONOGRAPH OF WEST AMERICAN PYRAMIDELLID MOLLUSKS

BY

WILLIAM HEALEY DALL and PAUL BARTSCH
Of the Division of Mollusks, U. S. National Museum

WASHINGTON
GOVERNMENT PRINTING OFFICE
1909

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ISSUED DECEMBER 13, 1909.

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This work forms No. 68 of the Bulletin series.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as bulletins.

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RICHARD RATHBUN,
Assistant Secretary, Smithsonian Institution,
In charge of the United States National Museum.

WASHINGTON, U. S. A., *November 10, 1909.*

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A MONOGRAPH OF WEST AMERICAN PYRAMIDELLID MOLLUSKS.

By William Healey Dall and Paul Bartsch,
Of the Division of Mollusks, U. S. National Museum.

INTRODUCTION.

The Pyramidellidæ are a family of mollusks mostly of small size and world-wide distribution. No record of unmistakable Pyramidellidæ has been found in the Cretaceous faunas, though such may occur, but they are numerous in the Tertiaries and perhaps most fully represented in the existing faunas.

Numerous names have been applied to them; sometimes a particular group has been supposed to have no plication on the pillar, a mistake which can be corrected by grinding down the whorls so as to expose the interior more fully than may be done by inspecting the natural aperture. The plication in such cases is present, but falls short of reaching a point where it can be observed through the aperture.

In all the species of which the soft parts are known the external anatomy is very similar. In examining a large number of species, as noted by Fischer, intermediate types occur, until it becomes a matter of great difficulty to decide where, if anywhere, the generic lines can be drawn. It is not surprising that some authors have resorted to the expedient of regarding most of the species, notwithstanding the contrasted extremes of the series, as belonging to a single genus. When a group is composed of such a multitude of species, it seems more convenient in practice and leads more efficiently to clear thinking to take the other view, and subdivide the groups sufficiently to make it reasonably clear where a given species belongs in the series.

In the absence of anatomical characters it has been necessary to fall back in large part on the form and sculpture of the shell the presence or absence of an umbilicus, and the character of the plications on the pillar, as distinctive characters, although it must be admitted that between the different sections some intermediate forms may occur. So many names have been applied to members of the group that in most cases it has not been necessary to coin new denominations. The synonymy, which is often much involved, is treated of in the text which follows.

The classification adopted is essentially that proposed by us in our synopsis of the family published in February, 1904. Some revision and some additions as was expected have been found necessary.

Many of the specific names given in the past by different authors have been repeatedly used for different species, rendering it necessary in many cases to give new ones. In all cases the synonymy of group names adopted has been based on researches which began with the typical species of the original authors, which in the case of some of the more anciently named forms has involved no little labor.

When any doubt existed in regard to the internal characters the specimens have been ground down until the pillar has been made visible over a great part of its extent, and in all cases the characters recorded are the result of microscopical examination. Only a few of the many named forms have been inaccessible, as the collection of the U. S. National Museum is remarkably rich in species of this group, while the junior author, during a recent visit to England, has been able to examine the original types of Carpenter and Adams in the British Museum, and later visited Amherst, Massachusetts, to confirm earlier notes on the types contained in the C. B. Adams collection, the property of Amherst College. The Zoological Museum of Berlin, Germany, submitted its entire collection for study, and the authorities of the Zoological Museum of Copenhagen, of the Academy of Natural Sciences of Philadelphia, and of Amherst College, of the University of California, of the U. S. Bureau of Fisheries, of the Field Museum of Chicago, of the American Museum of Natural History, New York City, granted facilities for study, for photographing type-specimens or at various times loaned material required for study. The facilities of the National Museum have, of course, been at the disposition of the writers, and most of the types of species form part of its collection.

The amount of assistance rendered by private correspondents and collectors has been very large. Many of the friends of the Museum have sent in all their Pyramidellid material, and have allowed it to remain for study, in some cases several years. Others have generously resigned the opportunity of working up themselves the material they had collected and have donated to the Museum type-specimens of rare and even unique forms. For this generous assistance we are deeply indebted. Among those to whom we desire to make the most cordial acknowledgment are Mr. and Mrs. T. S. Oldroyd, Mr. Herbert N. Lowe, and Mrs. Eshnaur, of Long Beach, California; Dr. Fred Baker, Prof. F. W. Kelsey, Mrs. Kate Stephens, Mr. Henry Hemphill, Mr. C. W. Gripp, of San Diego; Mr. Fred L. Button, of Oakland; Mr. S. S. Berry and Mr. J. H. Paine, of Stanford University; Rev. Dr. G. W. Taylor, of Nanaimo, British Columbia; Hon. Delos Arnold and Dr. Ralph Arnold, of Pasadena, California; and Dr. R. E. C. Stearns, of Los Angeles, California; Mr. E. A. Smith, of the British Museum, and Dr. G. W. Chaster, of Southport, England. Among those who have contributed material bearing on the general subject though not on the West American fauna in particular, we are especially indebted to Rev. H. W. Winkley, of Danvers, Massachusetts. Material in the collection of the U. S. National Museum, contributed without special reference to this monograph, was received from Mr. Belding, Mr. S. A. L. Brannan, Mr. Blood, Mr. J. G. Cooper, Mr. P. P. Carpenter, Dr. W. H. Dall, Mr. G. H. Eldridge, Mr. W. J. Fisher, Mr. Hansen, Dr. George Hewston, Mr. O. B. Johnston, Mr. E. Jewett, Mr. Trevor Kincaid, Mr. C. B. Kennerley, Mr. A. Krause, Mrs. Merrihew, Dr. C. F. Newcombe, Capt. H. Nichols, U. S. Navy, Mr. C. R. Orcutt, Dr. E. Palmer, Mr. E. S. Roper, Mr. J. G. Swan, Mr. J. O. Snyder, Mr. Turrill, Mr. F. Woodworth, and Mr. J. Xantus. We have had the advantage of consulting specimens from the Eocene of the Paris Basin, named by M. Maurice Cossmann, of Paris. Lastly, the Jeffreys collection with its multitude of specimens, author's examples, types, and cotypes, of British, abyssal Atlantic, north European, and Mediterranean species, has been a means of reference without which we should have been in numerous instances most seriously handicapped.

The senior author desires to say that with the exception of this introduction and a certain amount of editorial supervision and advisory assistance, the labor of microscopically studying the specimens and preparing the manuscript of this paper is the work of the junior author, to whom the credit should be given. This labor has been very great and has been performed in the intervals of other work officially more pressing. We hope, therefore, that friends who have from time to time intrusted us with material which has often been retained for a considerable time before being returned to its owners, will make allowances for what has in no case been intentional delay or neglect.

We may here repeat an explanation printed in 1904, that the Museum Calonnianum is an anonymous pamphlet with no publisher's name attached to it, no diagnosis or figures, and which was not prepared by George Humphrey, the dealer who distributed it. We have therefore declined to regard the name *Obeliscus*, which is contained in it, as having been regularly published, or as having precedence over *Pyramidella* Lamarck.

A brief historical review of the progress of the study of the Pyramidellidæ on the western shores of the two Americas may be in place here.

While it is probable that Hugh Cuming, in the first third of the nineteenth century, during his researches on the coast of western South America, may have collected some Pyramidellidæ, the systematists who described his novelties after his return to England were long busy with the larger, more attractive, and more conspicuous shells.

The first Pyramidellid described was named by Alcide D'Orbigny in 1840, in the report of his voyage to South America, the *Chemnitzia cora* from Peru.

The next contribution was that of Prof. C. B. Adams, of Amherst College, in his account of the shells of Panama, published in 1852, in the Annals of the Lyceum of Natural History of New York. It included the following species: *Pyramidella conica; Chemnitzia aculeus, acuminata, affinis, clathratula, communis, gracilior, major, marginata, panamensis, similis, striosa, turrita; Cingula inconspicua, paupercula, terebellum*, and *turrita*.

In the same year Dr. A. A. Gould described, in the Boston Journal of Natural History, from Mexico and the Gulf of California, the following species: *Odostomia gravida* and *achates; Chemnitzia torquata.*

In 1854, Karl Theodor Menke, in the Malakozoölogische Blätter, described *Pyramidella bicolor*, from California. In the same year Arthur Adams, editing the Pyramidellidæ of Sowerby's Thesaurus Conchyliorum, named *Obeliscus hastatus* and *clavulus*.

The most numerous addition to the known species of the coast yet made appeared in 1856 in the Mazatlan Catalogue of the Reigen collection in the British Museum, by Dr. Philip P. Carpenter. This comprised the following forty species: *Odostomia sublirulata, lamellata, subsulcata, vallata, mammillata, tenuis; Parthenia scalariformis, quinquecincta, lacunata, armata, exarata, ziziphina; Chrysallida ovata, nodosa, rotundata, oblonga, telescopium, reigeni, effusa, fasciata, ovulum, convexa, photis, indentata, clausiliformis; Chemnitzia c-b-adamsi, muricata, prolongata gibbosa, gracillima, undata, flavescens, terebralis, tenuilirata, unifasciata; Dunkeria paucilirata, subangulata, cancellata, intermedia;* and *Eulimella obsoleta.* Camera drawings of these by Doctor Carpenter are among the archives of the U. S. National Museum.

Mörch, in the Malakozoölogische Blätter for 1859, describes *Turbonilla craticulata, subula*, and *cinctella.* Baird in the Proceedings of the Zoological Society of London, 1863, names *Chemnitzia vancouverensis.*

In the report of the British Association for the Advancement of Science for 1863, Dr. P. P. Carpenter names the following species: *Pyramidella adamsi; Obeliscus variegatus; Odostomia nuciformis*, and variety *avellana, O. satura* and variety *gouldii, O. inflata, straminea, tenuisculpta, cincta*, and *pumila; Dunkeria laminata; Chemnitzia tridentata, chocolata* varieties *aurantia, subcuspidata*, and *stylina, C. virgo;* all these have a few words of diagnosis, but not enough to identify them. They were more fully described later. The same author in the Annals and Magazine of Natural History for 1864, pages 46–47, describes *Obeliscus variegatus*, *Odostomia* (*Evalea*) *æquisculpta* and *delicatula*, and *Chrysallida angusta*. In the same publication for 1865 he describes *Odostomia satura*, *gouldii*, *nuciformis*, *avellana*, *tenuisculpta*, and *inflata; Chemnitzia crebrifilata*, variety *stylina*, and *virgo; Dunkeria laminata;* and *Chemnitzia cœlata*.

In the Journal de Conchyliologie for April, 1865, Doctor Carpenter names *Odostomia straminea*, *Chemnitzia tridentata*, and (var.?) *aurantia*. The last contribution to the knowledge of this group made by Doctor Carpenter was during the following year, when in the Proceedings of the California Academy of Sciences, page 219, he describes *Chrysallida pumila*.

William M. Gabb, in the same publication (p. 186) a year earlier had added *Turbonilla gracillima* (now *T. gabbiana*) to the California fauna.

In a separate publication on the minute shells found on imported pearl oysters, and entitled "Les Méléagrinicoles," in 1867 the Marquis de Folin describes from the Pacific coast (?) *Turbonilla festiva* and *Chemnitzia rangii*.

In 1870, in the American Journal of Conchology, page 66, Dr. J. G. Cooper changes the preoccupied name *Turbonilla gracillima* Gabb into *T. gabbiana* Cooper.

In the series entitled "Les Fonds de la Mer," vol. 2, 1872, the Marquis de Folin describes the following species: *Salassia carinata; Noëmia proxima*, *pulchra*, *angusta*, with varieties *contracta* and *ovata; Odetta recta* and *elegans*.

Among some Vancouver shells described in the Annals and Magazine of Natural History for 1880, by Mr. E. A. Smith, we find *Chemnitzia lordi*.

In the report on the Gastropoda of the Blake expedition, 1889, Dall describes *Pyramidella auricoma;* and in the Bulletin of the Natural History Society of British Columbia, 1897, page 14, he names *Mumiola tenuis*, subsequently found to be preoccupied, and renamed *Odostomia* (*Menestho*) *pharcida* Dall and Bartsch.

In Zoë (vol. 4, 1894, p. 395), Hemphill named a shell *Fulimella occidentalis*, but this has proved not to be a Pyramidellid.

In a monograph in the new edition of the Conchylien Cabinet of Martini and Chemnitz, Clessin named *Odostomia krausei* and *panamensis*, in 1900.

In a memoir by Dr. Ralph Arnold on the Marine Pliocene and Pleistocene of San Pedro, California, the portion relating to the Pyramidellidæ was prepared by the authors of the present paper, March, 1903. Twenty-three species are treated of, the types of which are in the National Museum, and of these the following are regarded as new: *Turbonilla pentalopha, auricoma, latifundia, lowei* and variety *pedroana, arnoldi*, and *adleri; Odostomia stearnsii, diegensis*, and *grammatospira.*

In 1904, the present authors prepared and published in the Proceedings of the Biological Society of Washington a Synopsis of the Genera, Subgenera, and Sections of the Family Pyramidellidæ. This hardly admits of condensation, but contains numerous new divisional names and the descriptions of the following new species serving as types of groups named in the table: *Pyramidella* (*Sulcorinella*) *dodona, Turbonilla* (*Baldra*) *archeri, Odostomia* (*Vilia*) *pilsbryi*, and *Odostomia* (*Evalina*) *americana*, of which, however, only the last-mentioned is a native of the Pacific coast.

In 1906, through the kind intervention of the late Prof. Eduard von Martens, in charge of the conchological collection of the Berlin Zoological Museum, we received for study their entire series of Pyramidellidæ, including numerous author's types derived from many sources, of which the most important were from the collections of the late Henry and Arthur Adams, of Paetel, of Dunker, of Clessin and of Hilgendorf. Numerous species inadequately described by Arthur Adams were included, and were for the first time figured and placed on a valid basis in the report on this collection.[a] Among the species discussed or described from the west coast of America in this report were the following: *Odostomia* (*Evalea*) *sitkaënsis* Clessin, *O.* (*Amaura*) *martensi* n. n., *O.* (*A.*) *krausei* Clessin, *O.* (*Heida*) *panamensis* Clessin; *Pyramidella* (*Longchæus*) *bicolor* Menke, *P.* (*Pharcidella*) *hastata* A. Adams, and *P.* (*P.*) *moffati*, n. n.

In 1907,[b] the present writers discussed the Pyramidellid mollusks of the Oregonian faunal area. In that paper the following new species, or names, appear for the first time: *Turbonilla gilli* (and subspecies *delmontensis*); *T.* (*Chemnitzia*) *montereyensis* n. n. (= *gabbiana* J. G. Cooper), *T.* (*C.*) *muricatoides; T.* (*Strioturbonilla*) *serræ; T.* (*Pyrgolampros*) *taylori, T.* (*P.*) *berryi, T.* (*P.*) *lyalli, T.* (*P.*) *victoriana, T.* (*P.*) *valdezi, T.* (*P.*) *newcombei, T.* (*P.*) *oregonensis; T.* (*Pyrgiscus*) *canfieldi, T.* (*P.*) *mörchi, T.* (*P.*) *antestriata, T.* (*P.*) *eucosmobasis, T.* (*P.*) *castanea* (= *castanella*, Dall, later); T. (*Mormula*) *eschscholtzi; Odostomia* (*Chrysallida*) *cooperi, O.* (*C.*) *astricta, O.* (*C.*) *montereyensis, O.* (*C.*) *oregonensis, O.* (*Ividia*) *navisa* (and subspecies *delmontensis*); *O.* (*Iolæa*) *amianta; O.* (*Menestho*) *pharcida* n. n., *O.* (*M.*) *harfordensis, O.* (*M.*) *exara; O.* (*Evalea*) *tillamookensis, O.* (*E.*) *angularis, O.* (*E.*) *jewetti, O.* (*E.*) *columbiana, O.* (*E.*) *deliciosa, O.* (*E.*) *tacomaënsis, O.* (*E.*) *valdezi, O.* (*E.*) *phanea; O.* (*Amaura*) *kennerleyi*, and *O.* (*A.*) *montereyensis* (preoccupied, later *O. canfieldi* Dall).

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[a] Proc. U. S. Nat. Mus., vol. 30, pp. 321 to 369, with ten plates.

[b] Idem, vol. 33.

Two of the species above mentioned having been inadvertently given names which had already been used, W. H. Dall in the Nautilus for March, 1908, proposed the new names *Turbonilla* (*Pyrgiscus*) *castanella* and *Odostomia* (*Amaura*) *canfieldi*, for *T. castanea* and *O. montereyensis*.

In 1908,[a] Dall describes *Odostomia* (*Evalea*) *atossa* from San Pedro, California.

It would have extended this review to inordinate length had we attempted to refer to the instances where west American species are merely alluded to in the literature.

The drawings with which the present paper is illustrated were mostly made by Miss Evelyn G. Mitchell; some of them were the work of our regretted collaborator, the late Dr. J. G. McConnell.

The temperatures of seawater cited in the text are in degrees of the Fahrenheit scale.

CLASSIFICATION.

Family PYRAMIDELLIDÆ.[b]

Gastropods with the radula absent or obsolete; the operculum ovoid paucispiral, with the apex anterior, a thread-like arcuate ridge on the proximal side, the inner margin notched in harmony with the plaits of the pillar when prominent; foot short, moderately pointed behind, with a small operculigerous lobe above and sometimes a small tentacular appendix on each side, in front feebly auriculate or undulate; mantle feebly canaliferous on the right upper margin; a single branchia; verge subcylindric, elongate; head with two flattened subtriangular or elongate tentacles, connate, grooved or auriform in the larger forms, the funicles with a ciliated area; eyes behind or between the bases of the tentacles; below the tentacles an oral orifice from which extends a long retractile subcylindric proboscis, but there is no muzzle like that of *Scala;* below the oral orifice is an organ named by Lovèn the *mentum*, which is usually more or less medially grooved or fissured, and hence, at its anterior end, more or less bilobate, and extensile or retractile before or behind the front margin of the foot. The shell is turrited, with a plicate axis;

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[a] Proc. U. S. Nat. Mus., vol. 34.

[b] In the preparation of the present diagnoses the following terminology is used:

"Axial sculpture," the markings which extend from the summit of the whorls toward the umbilicus.

The axial sculpture may be—

"Vertical," when the markings are in general parallelism with the axis of the shell.

"Protractive," when the markings slant forward from the preceding suture.

"Retractive," when the markings slant backward from the suture.

"Spiral sculpture," the markings following the directions of the coils of the whorls.

the outer lip frequently internally lirate; in the larger forms the aperture is obscurely channeled in front; the larval shell is sinistral the adult dextral, the former frequently set at an angle to the adult axis, or more or less immersed in the adult apical whorls; it is usually helicoid and smooth; the sculpture varies from nothing to ribbed, spirally sulcate or reticulate; the coloration when present usually reddish, brownish or yellow. The eggs are numerous and deposited in a lenticular mass. The distribution is world-wide, but the larger forms are mostly tropical.

SYNOPSIS OF THE GENERA, SUBGENERA, AND SECTIONS.

SYNOPSIS OF THE GENERA.

Genus PYRAMIDELLA Lamarck.

Shell elongate-conic, whorls usually inflated and regularly increasing; the pillar with from one to three folds; the outer lip entire; the shell usually larger than in *Turbonilla*.

Type.—*Trochus dolabratus* Linnæus.

Genus TURBONILLA Risso.

Shell cylindro-conic, many whorled, generally slender; columellar fold single, varying in strength, outer lip entire; shell usually smaller than in *Pyramidella* and larger than in *Odostomia*.

Type.—*Turbonilla typica* Dall and Bartsch=*Turbonilla plicatula* Risso, not *Turbo plicatulus* Scacchi.

Genus ODOSTOMIA Fleming.

Shell usually short, few whorled, subconic or ovate; columellar fold single, varying in strength, outer lip entire.

Type.—*Turbo plicatus* Montague.

Genus MURCHISONELLA Mörch.

Shell minute, cylindro-conic; outer lip with an anal sinus behind the periphery of the whorl; pillar with the plait obsolete or internal. whorls numerous and inflated.

Type.—*Murchisonella spectrum* Mörch.

KEY TO THE SUBGENERA OF PYRAMIDELLA.[a]

A¹ Columellar folds three.

Shell umbilicated.

Basal fasciole absent, surface polished, marked by extremely faint lines of growth and microscopic spiral striations.

Subgenus **Pyramidella** Lamarck, s. s., 1799 (p. 19).
Type, *Trochus dolabratus* Linnæus.

Basal fasciole present, surface less polished than in *Pyramidella* s. s., marked by lines of growth and microscopic spiral striations.

Subgenus **Milda** Dall and Bartsch, 1904 (1).
Type, *Obeliscus ventricosus* Quoy.

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[a] In order to keep the key in its present compact form we have placed all references to citations and synonyms at the end of the key. The numbers in brackets (1–45) following the names refer to the citations.

A¹ Columellar folds three—Continued.
  Shell not umbilicated.
    Surface polished, marked only by fine lines of growth and microscopic spiral striations.
      Periphery sulcate.
        Subgenus **Longchæus** Mörch, 1875 (p. 21).
          Type, *Pyramidella punctata* Schubert and Wagner.

      Periphery not sulcate.
        Subgenus **Voluspa** Dall and Bartsch, 1904 (p. 19).
          Type, *Pyramidella auricoma* Dall.

    Surface sculptured.
      Basal cords absent.
        Periphery sulcate.
          Shell marked by strong axial ribs which terminate at the periphery, and microscopic spiral striations.
            Subgenus **Pharcidella** Dall, 1889 (p. 25).
              Type, *Pharcidella folinii* Dall.

          Shell marked by strong spiral keels and weak axial riblets.
            Subgenus **Callolongchæus** Dall and Bartsch, 1904 (2).
              Type, *Pyramidella jamaicensis* Dall.

        Periphery not sulcate.
          Shell marked by strong axial ribs, intercostal spaces strongly spirally striated, aperture auricular.
            Subgenus **Otopleura** Fischer, 1885 (3).
              Type, *Pyramidella auris-cati* Chemnitz.

      Basal cords present.
          Shell marked by strong spiral ridges, moderately strong axial ribs and two basal cords.
            Subgenus **Triptychus** Mörch, 1875 (4).
              Type, *Triptychus niveus* Mörch.

A² Columellar folds two.
  Shell umbilicated.
    Surface polished, marked by very fine lines of growth and microscopic spiral striations.
            Subgenus **Tiberia** Monterosato, 1875 (5).
              Type, *Pyramidella nitidula* A. Adams.

    Surface polished, marked by fine lines of growth and strong spiral striations.
            Subgenus **Ulfa** Dall and Bartsch, 1904 (2).
              Type, *Pyramidella* (*Ulfa*) *cossmanni* Dall and Bartsch
              =*Syrnola striata* Cossmann.

    Surface marked by strong axial ribs, intercostal spaces spirally pitted; early post-nuclear whorls sculptured differently from the later ones.
            Subgenus **Tropæas** Dall and Bartsch, 1904 (2).
              Type, *Pyramidella subulata* A. Adams.

  Shell not umbilicated.
    Surface polished, marked by very faint lines of growth and microscopic spiral striations.
      Basal fasciole present.
            Subgenus **Vagna** Dall and Bartsch, 1904 (2).
              Type, *Pyramidella paumotensis* Tryon.

A^2 Columellar folds two—Continued.
  Shell not umbilicated—Continued.
    Surface polished, marked by very faint lines of growth and microscopic spiral striations—Continued.
      Basal fasciole absent.
          Subgenus **Eulimella** Forbes, 1846 (6).
            Type, *Eulimella crassula* Forbes, =*E. scillæ* Scacchi.

        Aperture subquadrate.
          Section **Eulimella** Forbes, s. s.
        Aperture suboval.
          Section **Cossmannica** Dall and Bartsch, 1904 (7).
            Type, *Pyramidella clandestina* Deshayes.

A^3 Columellar fold one.
  Shell umbilicated.
    Surface polished, or with fine lines of growth and microscopic spiral striations.
      Peripheral sulcus absent.
          Subgenus **Orinella** Dall and Bartsch, 1904 (8).
            Type, *Orina pinguicula* A. Adams.

      Peripheral sulcus present.
          Subgenus **Sulcorinella** Dall and Bartsch, 1904 (8).
            Type, *Pyramidella* (*Sulcorinella*) *dodona*, Dall and Bartsch.
  Shell not umbilicated.
    Large, heavy, elongated shells.
      Surface spirally lirate.
          Subgenus **Actæopyramis** Fischer, 1885 (9).
            Type, *Monoptygma striata* Gray.

    Slender, medium sized shells.
      Surface polished, marked by fine lines of growth and microscopic spiral striations.
        Postnuclear whorls increasing slowly in size at first, then rapidly, lending the shell a mucronate appearance.
          Subgenus **Styloptygma** A. Adams, 1860 (10).
            Type, *Monoptygma stylina* A. Adams.

        Postnuclear whorls increasing regularly in size.
          Subgenus **Syrnola** A. Adams, 1860 (11).
            Type, *Syrnola gracillima* A. Adams.

        Aperture suboval.
          Section **Syrnola** A. Adams, s. s.

        Aperture subquadrate.
          Section **Stylopsis** A. Adams, 1860 (12).
            Type, *Stylopsis typica* A. Adams.

      Surface spirally striated.
          Subgenus **Iphiana** Dall and Bartsch, 1904 (8).
            Type, *Syrnola densistriata* Garrett.

      Surface axially and spirally striated with a strong spiral keel at the summit of the whorls.
          Subgenus **Syrnolina** Dall and Bartsch, 1904 (8).
            Type, *Syrnola rubra* Pease.

The status of *Agatha virgo* A. Adams 1860, [*Menestho*, 1861, *Myonia*, 1861, *Amathis* 1861], is not known to us. From the meager description we are inclined to believe that it is allied to *Actæopyramis* Fischer.

KEY TO THE SUBGENERA OF TURBONILLA.

A¹ Shells without basal keels.
  B¹ Varices absent.
    Spiral sculpture absent, or if present consisting of microscopic striations only.
      Surface of the early post-nuclear whorls marked by feeble axial ribs, later ones smooth.
          Subgenus **Ptycheulimella** Sacco, 1892 (p. 59).
            Type, *Tornatella pyramidata* Deshayes.

      Surface marked by strong axial ribs which terminate at the periphery of the whorls, intercostal spaces excavated between the sutures.
        Nuclear whorls helicoid on planorboid.
          Subgenus **Chemnitzia** Orbigny, 1839 (p. 33).
            Type, *Melania campanellæ* Philippi.

        Nuclear whorl elongate pupoid.
          Subgenus **Nisiturris** Dall and Bartsch, 1906.
            Type, *Chemnitzia crystallina* Dunker.
      Surface marked by strong axial ribs and intercostal spaces which extend over the periphery to the umbilical region.
          Subgenus **Turbonilla** Risso, 1826 (p. 29).
            Type, *Turbonilla* {*typica* Dall and Bartsch= *plicala* Risso.

    Spiral sculpture present, always stronger than microscopic striations.
      C¹ Axial sculpture consisting of well developed ribs.
        Spiral markings consisting of many very fine spiral striations.
          Aperture subquadrate.
            Shell with peripheral sulcus.
              Pselliogyra, new subgenus.
                Type, *Turbonilla monocycla* A. Adams.
            Shell without peripheral sulcus.
              Subgenus **Strioturbonilla** Sacco, 1892 (p. 40).
                Type, *Strioturbonilla alpina* Sacco.

          Aperture suboval.
            Subgenus **Pyrgolampros** Sacco, 1892 (p. 59).
              Type, *Pyrgolampros mioperplicatulus* Sacco.

        Spiral marking absent between the sutures, base strongly spirally lirate.
            Subgenus **Sulcoturbonilla** Sacco, 1892 (14).
              Type, *Tornatella turricula* Eichwald.

        Spiral markings consisting of strong striations.
          Summits of the whorls strongly shouldered.
            Subgenus **Pyrgisculus** Monterosato, 1884 (p. 126).
              Type, *Melania scalaris* Philippi.

          Summits of the whorls not strongly shouldered.
            Subgenus **Pyrgiscus** Philippi, 1841 (p. 74).
              Type, *Melania rufa* Philippi.

        Spiral markings consisting of one or two strong punctate cords in the intercostal spaces between the sutures; whorls slightly shouldered.
            Subgenus **Pyrgolidium** Monterosato, 1884 (15).
              Type, *Pyrgolidium roseum* Montagu.

A¹ Shells without basal keels—Continued.
  B¹ Varices absent—Continued.
    Spiral sculpture present, always stronger than microscopic striations—Con.
      C¹ Axial sculpture consisting of well developed ribs—Continued.
        Spiral markings consisting of one or two strong cords; whorls somewhat overhanging.
          Subgenus **Tragula** Monterosato, 1884 (16).
            Type, *Odostomia fenestrata* Forbes.

        Spiral markings consisting of three to six raised threads between the sutures and lirations on the base; whorls strongly shouldered.
          Subgenus **Dunkeria** Carpenter, 1857 (p. 120).
            Type, *Dunkeria subangulata* Carpenter.

      C² Axial sculpture consisting of faint riblets
        Spiral markings consisting of strong raised threads.
          Subgenus **Cingulina** A. Adams, 1860 (17).
            Type, *Cingulina cingulata* Dunker.

        Spiral sculpture consisting of depressed lirations, sculpture granulose.
          Subgenus **Saccoina**, new name (18).
            Type, *Spica monterosatoi* Sacco.

      C³ Axial sculpture consisting of lines of growth only.
        Spiral markings consisting of many subequally spaced striations; sculpture finely reticulated.
          Subgenus **Careliopsis** Mörch, 1874 (19) (p. 130).
            Type, *Monoptygma* (*Careliopsis*) *styliformis* Mörch.

      C⁴ Axial sculpture absent.
        Spiral markings consisting of a broad strong fold at the summit of the whorls, separated from the rest of the whorl by a deep, broad, rounded sulcus.
          Subgenus **Visma** Dall and Bartsch (20).
            Type, *Eulimella tenuis* Sowerby.

  B² Varices present.
        Surface marked by axial ribs and strong spiral striations.
          Subgenus **Mormula** A. Adams, 1864 (p. 110).
            Type, *Mormula rissoina* A. Adams.

        Surface marked by axial ribs and strong spiral lirations, sculpture granulose.
          Subgenus **Lancella** Dall and Bartsch, 1904 (21).
            Type, *Turbonilla* (*Lancea*) *elongata* Pease.

A² Shells with basal keels.
      Axial sculpture consisting of strong ribs.
        Spiral sculpture absent.
          Subgenus **Asmunda** Dall and Bartsch (p. 129).
            Type, *Chemnitzia turrita* C. B. Adams.

        Spiral sculpture present.
          Spiral sculpture consisting of strong ridges.
            Basal keels two.
            Subgenus **Peristichia** Dall, 1889 (22).
              Type, *Peristichia toreta* Dall.

            Basal keels three.
            Subgenus **Babella** Dall and Bartsch, 1906 (23).
              Type, *Turbonilla* (*Babella*) *cælatior* Dall and Bartsch.

A² Shells with basal keels—Continued.
  Axial sculpture consisting of strong ribs—Continued.
    Spiral sculpture present—Continued.
      Spiral sculpture consisting of two tumid ridges, one at the periphery the other at the summit of the whorls, and many fine striations in the intercostal spaces.
        Subgenus **Baldra** (24).
          Type, *Turbonilla* (*Baldra*) *archeri* Dall and Bartsch.
  Axial sculpture consisting of lines of growth only.
      Spiral sculpture consisting of faint lirations.
        Subgenus **Discobasis** Cossmann, 1888 (25).
          Type, *Aciculina demissa* Deshayes.

KEY TO THE SUBGENERA OF ODOSTOMIA.

A¹ Postnuclear whorls sculptured similarly throughout.
  B¹ Varices absent.
    C¹ Axial ribs present, rounded.
      Spiral markings, when present, consisting of mere microscopic striations.
        Shell inflated.
          Summit of the whorls slightly shouldered.
            Subgenus **Elodiamea** De Folin, 1884 (26).
              Type, *Odostomia* (*Elodiamea*) *gisna*, new name = *Elodia elegans* De Folin, not *Odostomia* (*Evalea*) *elegans* A. Adams, 1860.
        Shell not inflated.
          Summit of the whorls not shouldered.
            Subgenus **Odostomiella** Bucquoy, Dautzenberg and Dollfus, 1883 (27).
              Type, *Rissoa doliolum* Philippi.
          Summit of the whorls tabulated.
            Subgenus **Salassia** De Folin, 1885 (p. 134).
              Type, *Odostomia* (*Salassia*) *tropidita*, new name = *Salassia carinata* De Folin.
      Spiral markings consisting of a strong, broad, raised cord at the summit of the whorls, separated from the remaining part by a strongly impressed spiral groove.
            Subgenus **Vilia** Dall and Bartsch 1904 (28).
              Type, *Odostomia* (*Vilia*) *pilsbryi* Dall and Bartsch.
      Spiral markings consisting of two tumid ridges, one at the periphery and one at the summit of the whorls; with many striations on the base.
            Subgenus **Folinella** Dall and Bartsch, 1904 (28).
              Type, *Amoura anguliferens* De Folin.
      Spiral markings consisting of several to many raised threads in the intercostal spaces, always less strongly developed than the axial ribs.
        Intercostal spaces crossed by equally spaced, raised spiral threads, sculpture reticulated.
            Subgenus **Trabecula** Monterosato 1884.
              Type, *Odostomia jeffreysiana* Monterosato (29).
        Intercostal spaces crossed by several raised spiral threads, base not spirally marked.
            Subgenus **Parthenina** Bucquoy, Dautzenberg, and Dollfus, 1883 (30).
              Type, *Turbo interstinctus* Montagu.

A¹ Postnuclear whorls sculptured similarly throughout—Continued.
  B¹ Varices absent—Continued.
    C¹ Axial ribs present, rounded—Continued.
      Spiral markings consisting of several to many raised threads in the intercostal spaces, always less strongly developed than the axial ribs—Con.
        Intercostal spaces crossed by several spiral threads, base spirally striated.
          Subgenus **Besla** Dall and Bartsch, 1904 (p. 135).
            Type, *Chrysallida convexa* Carpenter.

      Spiral markings consisting of strong, raised threads or cords, equal to or even stronger than axial ribs.
        Spiral cords equally spaced, and equally well developed between the sutures and on the base; sculpture nodulose throughout.
          Subgenus **Mumiola** A. Adams, 1864 (31).
            Type, *Monoptygma spirata* A. Adams.

        Spiral cords subequally spaced between the sutures, where the sculpture is nodulose; base spirally lirate and axially striated.
          Subgenus **Chrysallida** Carpenter, 1856 (p. 136).
            Type, *Chemnitzia communis* C. B. Adams.

        Spiral cords confined to the base.
          Subgenus **Egilina** Dall and Bartsch, 1906.
            Type, *Parthenia mariella* A. Adams (45).

      Spiral markings consisting of impressed lines.
        Spiral striations subequally spaced, present between the sutures and on the base of the whorls.
          Subgenus **Pyrgulina** A. Adams, 1864 (p. 169).
            Type, *Chrysallida casta* A. Adams.

        Spiral striations on the base only, periphery deeply sulcated, axial ribs extending to the umbilical region.
          Subgenus **Egila** Dall and Bartsch 1904 (p. 170).
            Type, *Parthenia lacunata* Carpenter.

        Spiral striations on the base only, axial ribs terminating at the periphery, which is not sulcated.
          Subgenus **Spiralinella** Chaster, 1901 (32).
            Type, *Turbo spiralis* Montagu.

    C² Axial ribs present, lamellar.
      Spiral markings lamellar.
        Ribs and spiral lamellæ moderately strong, subequally spaced between the sutures and on the base; sculpture cuspidate.
          Subgenus **Haldra** Dall and Bartsch, 1904 (p. 171).
            Type, *Chrysallida photis* Carpenter.

        Ribs and spiral lamellæ few, very strong.
          Subgenus **Ividella**, new name (p. 172).
            Type, *Odostomia* (*Ividia*) *navisa*, Dall and Bartsch.

    C³ Axial ribs present but very feeble, usually only indicated near the summit of the whorls.
      Spiral markings consisting of several strong, broad, tumid cords, one or more of the posterior cords crenulated.
          Subgenus **Miralda** A. Adams, 1864 (p. 176).
            Type, *Parthenia diadema* A. Adams.

A¹ Postnuclear whorls sculptured similarly throughout—Continued.
  B¹ Varices absent—Continued.
    C³ Axial ribs present but very feeble, usually only indicated near the summit of the whorls—Continued.
      Spiral markings consisting of many subequally spaced lirations.
        Whorls tabulated at the summit.
            Subgenus **Ivara** Dall and Bartsch, 1903 (p. 179).
              Type, *Odostomia* (*Ivara*) *turricula* Dall and Bartsch.

        Whorls not tabulated.
            Subgenus **Evalina** Dall and Bartsch, 1904 (p. 180).
              Type, *Odostomia* (*Evalina*) *americana* Dall and Bartsch.

    C⁴ Axial ribs usually reduced to mere lirations, frequently only present between the spiral ridges.
      Spiral markings consisting of moderately well-developed cords usually equally spaced and present between the sutures and on the base; axial ribs indicated by faint threads between the spiral sculpture.
        Shell umbilicated.
            Subgenus **Iolæa** A. Adams, 1867 (p. 181).
              Type, *Iole scitula* A. Adams.

        Shell not umbilicated.
            Subgenus **Menestho** Möller, 1842 (p. 184).
              Type, *Turbo albulus* Fabricius.

    C⁵ Axial ribs absent; axial sculpture represented by lines of growth only.
      Spiral markings consisting of many, usually subequally and universally distributed impressed lines.
        Shell elongate-conic.
            Subgenus **Evalea** A. Adams, 1860 (p. 192).
              Type, *Evalea elegans* A. Adams.

        Shell short, subglobose.
            Subgenus **Oda** Monterosato, 1901 (33).
              Type, *Odostomia dolioliformis* Jeffreys.

    C⁶ Axial sculpture absent, shell polished.
        Spiral markings consisting of two tumid ridges, one at the periphery and the other at the summit of the whorls.
            Subgenus **Cyclodostomia** Sacco, 1892 (34).
              Type, *Cyclodostomia mutinensis* Sacco.

        Spiral markings consisting of a more or less conspicuous tumid ridge on the summit of the whorls.
            Subgenus **Doliella** Monterosato, 1880 (35).
              Type, *Odostomia nitens* Jeffreys.

        Spiral markings consisting of a strong peripheral keel.
            Subgenus **Scalenostoma** Deshayes, 1863 (p. 229).
              Type, *Scalenostoma carinata* Deshayes.

        Spiral markings consisting of a peripheral sulcus.
            Subgenus **Jordaniella** Chaster, 1898 (36).
              Type, *Turbo nivosa* Montagu.

        Spiral sculpture absent or indicated only by extremely fine microscopic lines of growth or striæ; surface polished.
          Summits of the whorls with a strongly tabulated shoulder.
            Subgenus **Spiroclimax** Mörch, 1874 (37).
              Type, *Spiroclimax scalaris* Mörch.

A^1 Postnuclear whorls sculptured similarly throughout—Continued.
- B^1 Varices absent—Continued.
  - C^6 Axial sculpture absent, shell polished—Continued.
    - Summits of the whorls not tabulated.
      - Columellar fold present.
        - Peritreme discontinuous, aperture not rissoid.
          - Shell inflated, very large.
          - Subgenus **Amaura** Möller, 1842 (p. 218).
            - Type, *Amaura candida* Möller.

          - Shell not inflated.
          - Subgenus **Odostomia** Fleming, 1817 (p. 231).
            - Shell of medium size.
          - Section **Odostomia** Fleming, s. s. (p. 231).
            - Type, *Turbo plicatus* Montagu.

            - Shell rather large.
          - Section **Stomega** Dall and Bartsch, 1904 (38).
            - Type, *Odostomia conspicua* Alder.

            - Shell small.
          - Section **Brachystomia** Monterosato, 1884 (39).
            - Type, *Odostomia rissoidea* Hanley.

        - Peritreme continuous, aperture rissoid.
          - Subgenus **Heida** Dall and Bartsch, 1904 (p. 231).
            - Type, *Syrnola caloosaënsis* Dall.

      - Columellar fold obsolete.
        - Shell umbilicated.
          - Subgenus **Myxa** Hedley, 1903 (40).
            - Type, *Myxa exesa* Hedley.

        - Shell not umbilicated.
          - Peritreme continuous, aperture rissoid.
          - Subgenus **Pseudorissoina** Tate and May, 1900 (41).
            - Type, *Stilifer tasmanica* Tenison-Woods.

          - Peritreme not continuous, aperture not rissoid.
          - Subgenus **Liostomia** O. Sars., 1878 (42).
            - Type, *Rissœlla? eburnea* Stimpson.
- B^2 Varices present.
  - Shell smooth, axial sculpture indicated by a few varices, spiral sculpture wanting.
        - Subgenus **Oceanida** De Folin, 1870 (43).
            - Type, *Oceanida gradata* De Folin.

        - Shell with sublamellar axial ribs.
        - **Salassiella** new subgenus (p. 133).
            - Type, *Odostomia* (*Salassiella*) *laxa* new species.

A^2 Early postnuclear whorls sculptured differently from the later ones.
- Early postnuclear whorls loosely coiled, plain; later ones closely coiled with a spiral keel at the periphery and one at the summit of the whorls; base spirally lirate.
        - Subgenus **Lysacme** Dall and Bartsch (p. 132).
            - Type, *Chrysallida clausiliformis* Carpenter.

- Early postnuclear whorls axially ribbed, succeeded by one or two strongly spirally and faintly axially lirate whorls; the rest of the whorls are marked by a reticulated sculpture consisting of raised axial and spiral cords.
        - Subgenus **Obtortio** Hedley, 1899 (44).
            - Type, *Rissoa pyrrhacme* Melvill and Standen, 1899.

REFERENCES TO CITATIONS AND SYNONOMY OF THE GENERA, SUBGENERA, AND SECTIONS OF THE FAMILY PYRAMIDELLIDÆ.

The page references after a name in the key refer to the present paper, while the numbers refer to the data cited below.

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(3) Man. de Conch., 1885, p. 787.

(4) Malak. Blätt., vol. 22, 1875, p. 158.

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(7) *Cossmannica* Dall and Bartsch, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 6=*Diptychus* Cossmann, Cat. Coq. Fos. Env. Paris, 1888, p. 95; type, *Pyramidella clandestina* Deshayes, not *Diptychus* Milne Edwards, 1880.

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(12) Ann. Mag. Nat. Hist., 3d ser., vol. 5, 1860, p. 406.

(13) Proc. U. S. Nat. Mus., vol. 30, 1906, p. 341.

(14) I. Moll. del Piemonte e della Liguria, 1892, p. 92.

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(17) *Cingulina* A. Adams, Ann. Mag. Nat. Hist., 3d ser., vol. 6, 1860, p. 414;+*Oscilla* A. Adams, Idem, 1860, p. 418; type, *Oscilla lirata* A. Adams;+*Polyspirella* Carpenter, Proc. Bost. Soc. Nat. Hist., vol. 7, 1861, p. 407; type, *Chemnitzia trachealis* Gould.

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WEST AMERICAN PYRAMIDELLIDÆ.

Genus PYRAMIDELLA Lamarck.

Pyramidella LAMARCK, Prod. d'un Nouv. Class. des Coq., 1799, p. 76. =*Obeliscus* ANONYMOUS, Museum Calonnianum, 1797, p. 24. =*Pyramidellus* MONTFORT, Conch. Syst., vol. 2, 1810, p. 499.

Shell elongate-conic, increasing regularly in size with three folds on the columella in the subgenera *Pyramidella*, *Milda*, *Longchæus*, *Voluspa*, *Pharcidella*, *Callolongchæus*, *Otopleura*, and *Triptychus;* of these the first two are umbilicated, the rest imperforate. The following subgenera have two columellar folds, umbilicated: *Tiberia*, *Ulfa*, and *Tropæas;* imperforate: *Vagna*, *Eulimella*, and *Cossmanica*. In the uniplicate members *Orinella* and *Sulcorinella* are umbilicated and *Actæopyramis*, *Styloptygma*, *Syrnola*, *Stylopsis*, *Iphiana*, and *Syrnolina* imperforate. The shell is usually strongly polished and porcellanous in luster.

Type.—*Trochus dolabratus* Linnæus.

This genus is represented on the west coast by the subgenera *Pyramidella*, *Longchæus*, *Voluspa*, and *Pharcidella*.

KEY TO THE SUBGENERA OF PYRAMIDELLA.

- Shell with axial ribs...*Pharcidella*, p. 25.
- Shell without axial ribs.
  - Shell umbilicated...*Pyramidella* s. s., p. 19.
  - Shell not umbilicated.
    - Peripheral sulcus present.................................*Longchæus*, p. 21.
    - Peripheral sulcus absent..................................*Voluspa*, p. 19.

Subgenus PYRAMIDELLA Lamarck, s. s.

Pyramidella LAMARCK, Prod. d'un Nouv. Class. des Coq., 1799, p. 76. =*Obeliscus* ANONYMOUS, Museum Calonnianum, 1797, p. 24. =*Pyramidellus* MONTFORT, Conch. Syst., vol. 2, 1810, p. 499.

Shell of many whorls, turrited, umbilicated; columella with three folds; outer lip usually reënforced within, at irregular intervals, by spiral lamellar thickenings. The sculpture consists of mere lines of growth and very fine spiral striations.

Type.—*Trochus dolabratus* Linnæus.

PYRAMIDELLA (PYRAMIDELLA) BAIRDI, new species.

Plate 1, figs. 5, 5*a*.

Shell broadly conic, milk-white, with a narrow pale yellow band at the periphery, deeply, broadly umbilicated. Nuclear whorls at least two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-half immersed. Post-nuclear whorls well rounded. faintly roundly shouldered at the summit. Sutures well impressed. Periphery and base of the last whorl somewhat inflated, well rounded. Entire surface of spire and base marked by exceedingly fine lines of growth, and microscopic closely spaced spiral striations. Aperture rather large; posterior angle acute; outer lip thick within, where it is reenforced by six short spiral lirations, three of which fall anterior and three posterior to the periphery; columella straight, slender, provided with three folds, the posterior of one of which is strongly lamellar and at some little distance anterior to the insertion; the other two are less strongly developed and much more oblique.

The type (Cat. no. 73932, U.S.N.M.) has six post-nuclear whorls and measures: Length 5.1 mm., diameter 1.7 mm. It comes from the Gulf of California.

Named for W. Baird.

Subgenus VOLUSPA Dall and Bartsch.

Voluspa DALL and BARTSCH, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 4.

Shell of many whorls, turrited, smooth, devoid of all sculpture other than mere lines of growth; *not* umbilicated; columella provided with three folds; outer lip frequently reenforced within at irregular intervals by spiral lamellar thickenings.

Type.—*Pyramidella auricoma* Dall.

KEY TO THE SPECIES OF THE SUBGENUS VOLUSPA.

Adult of 11 whorls, slender, length under 15 mm	*auricoma.*
Adult of 11 whorls, stout, length over 25 mm	*cerrosana.*

PYRAMIDELLA (VOLUSPA) AURICOMA Dall.

Plate 1, fig. 3.

Pyramidella auricoma Dall, Blake Report, Gastropoda, 1889, p. 332.

Shell regularly elongate-conic, yellowish-white, with fine golden yellow spiral lines between the sutures and on the base. Nuclear whorls small, deeply obliquely immersed in the first post-nuclear turn. Post-nuclear turns well rounded, feebly shouldered at the summit, scarcely at all contracted at the sutures. Sutures weakly impressed. Periphery and base of the last whorl well rounded, smooth. Aperture irregularly oval; outer lip thin, reënforced deeply within by five strong spiral cords, one of which is at the periphery, two divide the space between this and the summit into three equal parts, and two a little less strong are on the base; columella strong, straight, posterior fold very strong and lamellar, oblique; anterior two about one-fourth as high as the posterior, very oblique; parietal wall glazed by a thin callus.

The type (Cat. no. 32268, U.S.N.M) and two additional specimens were collected by Dr. Edward Palmer in the Gulf of California. The type has ten post-nuclear whorls and measures: Length 10.6 mm., diameter 3.8 mm. Another specimen (Cat. no. 168681, U.S.N.M.) comes from Mazatlan, Mexico.

PYRAMIDELLA (VOLUSPA) CERROSANA, new species.

Plate 1, fig. 1.

Shell very large, broadly conic. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle, moderately shouldered at the summit, and moderately contracted at the sutures. Sutures well impressed. Periphery and base of the last whorl well rounded. Aperture ?; outer lip reënforced within by seven spiral lirations, one of which is at the periphery, three between this and the suture, of which the one next to the periphery is the strongest of all seven, while the two posterior to it are the weakest; the three anterior to the periphery are equally spaced and grow successively weaker; columella strong, straight; posterior fold very strong, lamellar; anterior two about one-fourth as strong, very oblique.

The type (Cat. no. 6332, U.S.N.M.) comes from Cerros Island, Lower California. It has lost the nucleus and early whorls; the ten remaining measure: Length 25.5 mm., diameter 10.2 mm.

Subgenus LONGCHÆUS Mörch.

Longchæus Mörch, Malak. Blätt., vol. 22, 1875, p. 158.

Shell elongate-conic, not umbilicated, having three columellar folds, a basal fasciole and peripheral sulcus. The entire surface is marked by fine lines of growth and microscopic spiral striations.

Type.—*Pyramidella punctata* Schubert and Wagner.

KEY TO THE SPECIES OF THE SUBGENUS LONGCHÆUS.

- Shell variegated...*adamsi*, p. 21.
- Shell not variegated.
  - Shell rose-purple anteriorly....................................*bicolor*, p. 22.
  - Shell brown.
    - Adult shell more than 18 mm. long..........................*mexicana*, p. 23.
    - Adult shell less than 14 mm. long.
      - Sutures very strongly channeled.........................*conica*, p. 23.
      - Sutures moderately channeled.......................*mazatlanica*, p. 24.

PYRAMIDELLA (LONGCHÆUS) ADAMSI Carpenter.

Plate 1, figs. 6, 6*a*.

Pyramidella adamsi Carpenter, Rept. Moll. West Coast Amer. Brit. Ass. Adv. Sci. (for 1863), 1864, pp. 546, 547. = *Obeliscus conicus* jun. Carpenter, Cat. Mazatlan Shells, 1856, pp. 409–10. = *Obeliscus variegatus* Carpenter, Ann. Mag. Nat. Hist., 3d ser., vol. 14, 1864, p. 46.

The type of this species is a very young individual of five post-nuclear whorls which was taken from a species of *Chama* at Mazatlan, Mexico. It is on tablet 1951 of the Liverpool collection in the British Museum.

Shell elongate-conic, early whorls white, later ones diversely variegated, frequently dark brown on the later turns. It is this striking variegated color pattern which at once distinguishes this species from the other west American forms. The spaces between the sutures are crossed by light areas, which are vertical in the middle, bending suddenly forward at the periphery and the summit, thus forming)-shaped areas. The space immediately below the peripheral sulcus on the base has short light areas, corresponding to those above the sulcus, but with retractive slant. The space between these light areas, near the summit, forms a series of elongated dark spots. The varices which are disposed at irregular intervals are chestnut brown, preceded usually by a band of white. Posterior half of the base light chestnut brown; anterior white. Nuclear whorls small, two, forming a planorboid spire whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-half immersed. Post-nuclear whorls flattened; moderately shouldered at the summit, which is crenulated. Periphery with a strong sulcus. Base moderately long, well rounded. Entire surface of spire and base marked by fine lines of growth and exceedingly fine, microscopic spiral striations. Aperture oval; outer lip thin, showing the following color marking within; a white zone at the periphery, a narrow chestnut band immediately posterior to the periphery and another at the summit, a broad band extending over half the base immediately below the peripheral zone; deep within, the lip is reënforced by five strong, spiral cords, one at the periphery, two on the base, and two between the periphery and the summit; columella strong, provided with a strong fasciole, posterior fold very strong, lamellar, anterior two very oblique, slender.

The specimen figured (Cat. no. 11866, U.S.N.M.) comes from La Paz, Mexico. It has lost the nucleus, the twelve remaining whorls measure: Length 11.3 mm., diameter 3.8 mm.

The following specimens have been examined:

U. S. N. M. cat. no.	No. of specimens.	Locality.	From whom received.	Depth, fathoms.	Temp., deg.	Disposition of material.
56764	1	San Diego, California				U. S. Nat. Mus.
46469	7	do	Stearns coll			Do.
109367	1	do	H. Hemphill			Do.
194465	1	Station 2901, off Santa Rosa Island, California.	U. S. Fish Com	55.1	48	Do.
105558	3	Scammon Lagoon, Lower California.	H. Hemphill			Do.
34171	1	La Paz, Lower California.	L. Belding			Do.
11866	1	do				Do.
46468	2	Gulf of California	Stearns coll			Do.

Cat. no. 206854, U.S.N.M., contains a young individual from Monterey, California, which is much smaller and more slender than the typical form, and may prove to be a new species when perfect material shall come to hand.

PYRAMIDELLA (LONGCHÆUS) BICOLOR Menke.

Plate 1, fig. 2.

Pyramidella bicolor MENKE, Malak. Blätt., vol. 1, 1854. p. 28.

Shell elongate-conic, shining. Early whorls white, the succeeding ones gradually acquiring a pinkish tinge, which deepens and finally tints the last whorl rose-purple. (Nuclear whorls decollated.) Post-nuclear whorls overhanging, flattened, slightly shouldered and minutely crenulated, and deeply sulcate at the periphery. Sutures strongly impressed. Base short, moderately rounded, with a weak fasciole at the insertion of the columella. Aperture?; (outer lip badly fractured); columella conic, moderately strong, provided with a strong lamellar fold at its insertion, a moderately strong median one and a weaker anterior to it; the last two much more oblique than the posterior.

The specimen described and figured (Cat. no. 13522, U.S.N.M.) comes from Guacamoyo, Mexico. It has eight post-nuclear whorls and measures: Length 9.8 mm., diameter 3.5 mm.

PYRAMIDELLA (LONGCHÆUS) MEXICANA, new species.

Plate 1, fig. 12.

Shell, large, robust, broadly conic, dull brown. (Nuclear whorls decollated.) All but the last post-nuclear whorl flattened, flatly shouldered and crenulated at the summit; the last inflated and well rounded. Periphery of the last whorl marked by a strong sulcus. Sutures channeled. Entire surface of spire and base marked by lines of growth, which are quite prominent on the last turn. Base inflated, strongly rounded, with a slender fasciole at the insertion of the columella. Aperture oval; posterior angle acute; slightly channeled anteriorly; outer lip thin, with a white band at the periphery, the remainder brown with darker colored lines, reenforced deeply within by five spiral cords, two of which are posterior and three anterior to the periphery; columella stout, conic, with a strong lamellar fold at its insertion and two much more oblique ones anterior to it.

The type (Cat. no. 105558, U.S.N.M.) comes from Scammon Lagoon, Lower California. It has lost the nucleus and probably the first post-nuclear turn; the thirteen remaining measure: Length 19 mm., diameter 6.5 mm. Another specimen (Cat. no. 56764, U.S.N.M.) was collected at San Diego, California.

PYRAMIDELLA (LONGCHÆUS) CONICA C. B. Adams.

Plate 1, fig. 9.

Pyramidella conica C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., 1852, p. 424.

Shell very regularly elongate, conic. Early whorls flesh-colored; later ones light brown with an occasional varix of flesh color. Nuclear whorls at least two and one-half, depressed helicoid, having their axis almost at right angles to that of the succeeding turns, in the first of which they are about half immersed. Post-nuclear whorls decidedly flattened, slightly shouldered and weakly crenulated at the summit, marked with a strong peripheral sulcus which is crossed by numerous axial threads. Periphery of the last whorl slightly angulated. Base short, well rounded, provided with a strong fasciole at the insertion of the columella. Entire surface of spire and base marked by numerous exceedingly fine lines of growth only. Aperture? Posterior angle acute; outer lip fractured, reënforced within by five slender lirations. Columella strong, slightly revolute. Posterior lamella very strong; anterior two much weaker and much more oblique. Parietal wall glazed with a faint callus.

Prof. C. B. Adams's type, at Amherst College, was collected at Panama Bay. It has thirteen post-nuclear whorls, and measures: Length 13 mm., diameter 4.3 mm.

The present species recalls *P.* (*L.*) *mazatlanica*, but differs in being in every way much larger and having the sutures decidedly more channeled.

PYRAMIDELLA (LONGCHÆUS) MAZATLANICA, new species.

Plate 1, fig. 7, *7a*.

Shell very regularly conic, horn color, with a little darker band on the middle between the sutures, which is bordered at its anterior margin by a faint light line. Nuclear whorls two, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about two-thirds immersed. Post-nuclear whorls flattened, scarcely at all contracted at the suture, with a narrow, very finely crenulated shoulder at the summit. Sutures well impressed. Periphery of the last whorl strongly, sharply, and deeply sulcate. Base short, well rounded, with a strong fasciole at the insertion of the columella. Entire surface of spire and base marked only by lines of growth. Aperture irregularly oval; posterior angle acute, with a moderate channel anteriorly; outer lip thin, reënforced by four strong internal lirations, two of which are above and two below the periphery; columella slender, twisted and revolute, posterior fold lamellar, anterior two slender and very oblique.

The type (Cat. no. 162714, U.S.N.M.) was dredged at the U. S. Bureau of Fisheries station 3019, in 14 fathoms, temperature 66°, on broken shell bottom, off Cape Tepoca, west coast of Mexico. It has thirteen post-nuclear whorls and measures: Length 11 mm., diameter 3.5 mm. Another specimen (Cat. no. 46468, U.S.N.M.) comes from the Gulf of California. Two tips (Cat. no. 46477, U.S.N.M.) come from San Diego. A fragment (Cat. no. 206855, U.S.N.M.) was dredged by the U. S. Bureau of Fisheries station 3566 in 3 fathoms, off San Diego, California.

SPECIES OF UNCERTAIN STANDING OF THE SUBGENUS LONGCHÆUS.

ODOSTOMIA LAMELLATA Carpenter.

Odostomia lamellata CARPENTER, Cat. Mazatlan Shells, 1856, p. 411.

Tablet 1954, British Museum, contains Carpenter's cotypes. One of these served for the description of the nucleus, and there is little more to it. The other is a badly fractured specimen which has lost the early whorls, the lip is broken so as to almost obliterate the two weak basal folds of the columella.

It may be a young specimen of *Pyramidella* (*Longchæus*) *mazatlanica*.

ODOSTOMIA SUBSULCATA Carpenter.

Odostomia subsulcata CARPENTER, Cat. Mazatlan Shells, 1857, p. 411.

The two cotypes on tablet 1955 in the British Museum show one strong and two weak basal folds on the columella. They are young badly worn specimens of some species of *Longchæus*.

ODOSTOMIA VALLATA Carpenter.

Odostomia vallata CARPENTER, Cat. Mazatlan Shells, 1857, pp. 411–412.

Tablet 1956 of the British Museum collection contains the three cotypes which like the above must be placed under *Longchæus* for the same reason.

Subgenus PHARCIDELLA Dall.

Pharcidella DALL, Bull. Mus. Comp. Zool., vol. 18, 1889, p. 233.

Shell of many whorls, turriculate, *faintly spirally striate*, not umbilicate; with faintly vertically ribbed sulcate periphery, surface of the whorls weakly ribbed; columellar folds three; outer lip usually provided with internal lirations.

Type.—Pharcidella folinii Dall.

KEY TO THE SPECIES OF THE SUBGENUS PHARCIDELLA.

Shell broadly conic, stout, large .... *hastata*, p. 25.
Shell narrowly conic, slender, small .... *panamensis*, p. 26.
Shell elongate-ovate.
  Aperture auricular .... *moffati*, p. 26.
  Aperture not auricular .... *achates*, p. 27.

PYRAMIDELLA (PHARCIDELLA) HASTATA A. Adams.

Plate 1, fig. 4.

Obeliscus hastatus A. ADAMS, Sowerby Thes. Conch., 1854, p. 811, pl. 171, fig. 24.

Shell broadly elongate, conic, pale yellowish to flesh-color, irregularly clouded with light brown, shining. (Nuclear whorls decollated.) Post-nuclear whorls flattened, decidedly crenulated at their summits, with faint grooves extending from the base of the crenulations down and across the whorls giving them the appearance of being obsoletely ribbed. Sutures deep and channeled. Periphery of the last whorl angular, deeply sulcate, sulcus more or less regularly closely transversely ribbed. Base well rounded, axially striated, the striæ extending to the umbilical region and over the posterior columellar fold. Basal fasciole present. Entire surface covered with microscopic spiral striations. Aperture suboval, subchanneled at the junction of the outer lip and columella, posterior angle acute. Columella straight and strong, posterior fold very strong, lamellar slightly oblique; anterior two of about equal size and much more oblique than the posterior one. Inner surface of the outer lip provided at intervals with five lirations, two posterior and three anterior to the peripheral sulcus.

Three specimens of this species, all with decollated apex, are in the collection of the U. S. National Museum (Cat. no. 59321). They were collected at Acapulco, Mexico. The one figured is the largest fragment. It has eight whorls, (if complete it would probably have fourteen) and measures: Length 11.5 mm., diameter 4.6 mm. The Dunker collection of the K. K. Zoological Museum of Berlin contains two specimens of this species.

PYRAMIDELLA (PHARCIDELLA) PANAMENSIS, new species.

Plate 1, fig. 8, 8a.

Shell slender, elongate-conic, horn-yellow, excepting the last whorl which is suffused with pale rose-purple. Nuclear whorls small, two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is a little more than half immersed. Post-nuclear whorls flattened, flatly shouldered at the summit, which is crenulated and decidedly channeled at the periphery, marked on the posterior half by feeble riblets which disappear before reaching the middle of the whorl. Sutures strongly channeled. Periphery of the last whorl with a deep sulcus, which is crossed by numerous very slender and closely spaced axial riblets. Base well rounded, with a strong fasciole about the columella. Aperture oval; posterior angle acute, slightly channeled anteriorly; outer lip thin; columella slender, revolute, provided with a lamellar posterior fold at the insertion of the columella, and two equally slender, very oblique ones anterior to it.

The type and another specimen (Cat. no. 122792, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2805, in 51 fathoms, mud bottom, in Panama Bay. It has twelve post-nuclear whorls and measures: Length 8.8 mm., diameter 3 mm.

PYRAMIDELLA (PHARCIDELLA) MOFFATI Dall and Bartsch.

Plate 1, fig. 11.

Obeliscus clavulus A. Adams, Sowerby Thes., 1854, p. 811, pl. 171, fig. 33, not *Obeliscus clavulus* (Ferussac) Beck, Index Moll., 1838, p. 62.=*Pyramidella* (*Pharcidella*) *moffati* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 323.

Shell moderately large, strong, early part of the spire broadly conic, later subcylindric, white, marked diversely with various shades of rust brown. (Nuclear whorls decollated.) Post-nuclear whorls moderately rounded, scarcely at all contracted at the periphery, narrowly shouldered at the summit, which is finely crenulated, marked by many lines of growth, some of which are a little stronger than the rest, the stronger corresponding to the crenulations at the summit and lend the surface the appearance of being obsoletely ribbed. Periphery of the whorls marked by a slender well-impressed spiral channel, which is not apparent in the suture in the first four whorls, but from the fifth on, the summit of the whorl drops more and more anterior to the peripheral sulcus until, on the last whorl, it is about one-fifth of the distance between the whorls posterior to the suture. Base of the last whorl rather prolonged, marked by lines of growth, provided with a strong basal fasciole. Aperture ear-shaped; posterior angle acute; outer lip thin, marked in the following manner within: A white band immediately below the summit, one-fourth of the width of the space between the sutures, followed by an interrupted band of dark rust brown, succeeded by a broad area, clouded with various shades of rust brown which connect the dark colored band with the white columellar area; columella moderately strong, provided with three oblique folds, the posterior one of which is lamellar; parietal wall covered with a thin callus.

The specimen described belongs to the Paetel collection, Berlin Museum. It has nine post-nuclear whorls and measures: Length 11.5 mm., diameter 4 mm. It was labeled *Obeliscus achates* Gould, cf. *crocatus* A. Adams, Japan. In the aperture of the shell a specimen of *Anachis diminuta* C. B. Adams, was firmly wedged, which species is at home on the west coast of Central America and Mexico. The *Pyramidella* therefore very likely belongs to the same region. The type of *O. clavulus* A. Adams, comes from Acapulco, Mexico.

It is much narrower with much higher whorls, decidedly less channeled periphery and narrower aperture than *P.* (*Pharcidella*) *achates* Gould.

PYRAMIDELLA (PHARCIDELLA) ACHATES Gould.

Plate 1, fig. 10.

Odostomia achates Gould, Bost. Journ. Nat. Hist., vol. 6, 1852, p. 385, pl. 14, fig. 13.

Shell stout, shining, milk-white, with irregular, flammulated spots of rust color, which are densest about one-third of the distance between the sutures anterior to the summits, where they form an almost continuous band. (Nuclear whorls decollated.) Post-nuclear whorls weakly rounded, slightly shouldered and faintly crenulated at the summit, marked by lines of growth, which are somewhat variable in strength, the strongest being on the side of the crenulations. Sutures well impressed. Periphery marked by a moderately strong, spiral sulcus. Base rather long, crossed by many lines of growth. Aperture elongate-pyriform, rather compressed laterally; posterior angle acute; outer lip thin; columella short, heavy, bounded by a low, strong basal fasciole, bearing three oblique folds, the posterior one of which is lamellar and situated a little anterior to the insertion of the columella; the other two folds are much less strongly developed and more oblique; parietal wall covered with a thin callus.

The type (Cat. no. 43, Orig. no. (228) A. 3111) is in the State Museum at Albany, New York. It is said to have been collected at Santa Barbara, California, which we consider doubtful. It seems more likely that it came from the Gulf of California. It has ten postnuclear whorls and measures: Length 11.6 mm., diameter 4.4 mm. The Academy of Natural Sciences, Philadelphia, has a specimen (Cat. no. 57870), collected by Colonel Jewett, at Mazatlan, Mexico, which has eight whorls and measures: Length 9.8 mm., diameter 4 mm. It is this specimen which has served for our figure.

Genus TURBONILLA Risso.

Turbonilla Risso, Hist. Nat. Eur. Mér., vol. 4, 1826, p. 224; *Euturbonilla* Semper, Arch. Nat. Fr. Meck., 1861, pp. 354–361. No type+*Elusa* A. Adams, Ann. Mag. Nat. Hist., 3d ser., vol. 6, 1861, p. 297. Type, *Elusa teres* A. Adams.

Shell with sinistral apex, cylindro-conic, many whorled, generally slender; with a single columellar fold which varies in strength and frequently is not visible in the aperture. The sculpture both axial and spiral ranges from obsolete to strongly incised lines or raised lamellæ.

Type.—*Turbonilla typica* Dall and Bartsch.

Of the twenty-four subgenera now recognized belonging to this genus, eleven occur on the west coast of America.

KEY TO THE SUBGENERA OF TURBONILLA.

- Shell with basal keel..*Asmunda*, p. 129.
- Shell without basal keel.
  - Varices present..*Mormula*, p. 110.
  - Varices absent.
    - Spiral sculpture absent, or if present, consisting of microscopic striations only.
      - Axial ribs strong.
        - Axial ribs between the sutures and on the base...*Turbonilla*, p. 29.
        - Axial ribs between the sutures only...............*Chemnitzia*, p. 33.
      - Axial ribs feeble, usually only developed on the early whorls, *Ptycheulimella*, p. 59.
    - Spiral sculpture present, always stronger than microscopic striations.
      - Axial sculpture consisting of well-developed ribs.
        - Spiral markings consisting of very fine striations.
          - Aperture subquadrate.....................*Strioturbonilla*, p. 40.
          - Aperture suboval..........................*Pyrgolampros*, p. 59.
        - Spiral markings consisting of strongly incised lines.
          - Summits of the whorls strongly shouldered.
            - Spiral sculpture consisting of very fine incised lines, *Pyrgisculus*, p. 126.
            - Spiral sculpture consisting of incised grooves and cords of about equal strength..................*Dunkeria*, p. 120.
          - Summits of the whorls not strongly shouldered..*Pyrgiscus*, p. 74.
      - Axial sculpture reduced to mere raised threads......*Careliopsis*, p. 130.

Subgenus TURBONILLA Risso, s. s.

Turbonilla Risso, Hist. Nat. Eur. Mer., vol. 4, 1826, p. 224. Type, *Turbonilla plicata* Risso. +*Euturbonilla* Semper (part), Arch. Nat. Fr. Meck., 1861, pp. 354–361. No type. +*Elusa* A. Adams, Ann. Mag. Nat. Hist., 3d ser., vol. 6, 1861, p. 297. Type, *Elusa teres* A. Adams.

Turbonillas without spiral sculpture, having prominent vertical ribs which extend from the summits of the whorls to the umbilical region; the same is true of the intercostal spaces. Usually both ribs and intercostal spaces are less strongly defined on the base below the periphery, than on the exposed portion of the whorls above it. Columella straight or slightly twisted. All our west coast forms belonging to this subgenus are small and slender, of semitranslucent bluish-white to milk-white color.

Type.—*Turbonilla typica* Dall and Bartsch=*T. plicata* Risso, 1826, not *Turbo plicatus* Brocchi, 1814.

KEY TO THE SPECIES OF THE SUBGENUS TURBONILLA.

- Whorls with a low rounded cord at the periphery.
  - Whorls strongly contracted at the suture..........................*gilli*, p. 29.
  - Whorls not strongly contracted at the sutures...............*delmontensis*, p. 30.
- Whorls without a cord at the periphery.
  - Summit of the whorls strongly tabulated..........................*centrota*, p. 30.
  - Summit of the whorls not tabulated.
    - Intercostal spaces and ribs marked by fine crinkly axial sculpture..*ima*, p. 31.
    - Intercostal spaces and ribs not marked by fine crinkly axial sculpture.
      - Whorls overhanging....................................*diegensis*, p. 31.
      - Whorls not overhanging.
        - Shell large (adult 10 mm.)..................................*acra*, p. 32.
        - Shell small (adult 6 mm. or less).
          - Axial ribs of penultimate whorl 30...............*lucana*, p. 32.
          - Axial ribs of penultimate whorl 22............*prolongata*, p. 33.

TURBONILLA (TURBONILLA) GILLI Dall and Bartsch.

Plate 2, fig. 8.

Turbonilla (*Turbonilla*) *gilli* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 493, 494, pl. 14, fig. 5.

Shell small, rather stout, inflated, dirty white. Nuclear whorls decollated, early post-nuclear whorls well rounded, later ones flat, broader at the summit than at the suture; sculpture of about fourteen strong, almost vertical, scalariform axial ribs on the second, and sixteen quite protractive ones on the succeeding whorls; on the penultimate turn, however, they are less oblique than on those preceding it. These ribs are very strongly developed at the summit of the whorls and render the deeply channeled suture decidedly coronated. Intercostal spaces deep, of about double the width of the ribs, interrupted suddenly at the decidedly angulated (almost keeled) periphery of the last whorl beyond which they reappear. Base strongly contracted, quite short, marked by the faint continuations of the axial ribs which extend to the umbilical region. Outer lip fractured; aperture? columella very strong, somewhat curved and revolute, provided with a subobsolete oblique fold.

The type and another specimen (Cat. no. 163009, U.S.N.M.) were collected by Mr. H. Hemphill at San Diego, California. The type has eight post-nuclear whorls, and measures: Length 3.3 mm., diameter 1.1 mm.

Two other lots belonging to the University of California have been examined—one, a single specimen, comes from station 30 off Catalina Island. The other three specimens were obtained at station 47, San Diego, California.

TURBONILLA (TURBONILLA) GILLI DELMONTENSIS Dall and Bartsch.

Plate 2, fig. 12.

Turbonilla (*Turbonilla*) *gilli delmontensis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 494, pl. 14, fig. 7.

Shell, similar to *T. gilli*, but much more stout and less turrited, with the ribs less strongly developed and the peripheral thickening only weakly represented. The type has lost the nuclear whorls, the eight remaining measure: Length 3.4 mm., diameter 1.2 mm.

Type.—Cat. no. 195921, U.S.N.M. was collected by Mr. S. S. Berry in 12 fathoms off Del Monte, Monterey, California.

TURBONILLA (TURBONILLA) CENTROTA, new name.

Plate 2, figs. 6, 6*a*.

=*Chemnitzia acuminata* C. B. Adams, Ann. Lyc. Nat. Hist. of N. Y., 1853, p. 388.
=*Chrysallida acuminata* C. B. Adams, Proc. Zool. Soc., 1863, p. 351. Not *Turbonilla acuminata* Goldfuss, = *Turritella acuminata* Goldfuss, 1852; nor *Chemnitzia acuminata* Keyserling 1846 (not a *Turbonilla*).

Shell very broadly conic, tabulatedly shouldered, milk-white. Nuclear whorls two and one-half, forming a decidedly elevated spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is slightly immersed. Post-nuclear whorls with decidedly tabulated summits, constricted at the sutures, well rounded, ornamented by strong, narrow, protractive axial ribs. Of these ribs 14 occur upon the first, 16 upon the second and third, 18 upon the fourth and fifth, and 20 upon the penultimate turn. Intercostal spaces a little more than twice as wide as the ribs, well impressed, terminating at the periphery. Sutures very strongly marked. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, somewhat curved and slightly revolute.

The specimen described is C. B. Adams's type and is registered as number 219 Amherst College. It is a mature specimen of seven post-nuclear whorls and measures: Length 2.8 mm., diameter 1.1 mm. It was collected at Panama.

TURBONILLA (TURBONILLA) IMA, new species.

Plate 2, fig. 1.

Shell large, elongate-conic, yellowish-white. (Early whorls eroded.) Those of the post-nuclear whorls remaining are very high between the sutures, slightly rounded, feebly shouldered at the summit, and somewhat contracted at the sutures, marked by low, rounded, somewhat sinuous, vertical axial ribs, of which there are 24 upon the penultimate whorl and 20 upon the second above it. Intercostal spaces about one and one-half times as wide as the ribs, shallow, scarcely depressed below the general surface. The intercostal spaces and ribs between the sutures are marked by rather strong lines of growth, which gives them a decidedly crinkly appearance. Sutures well impressed. Periphery and base of the last whorl well rounded, marked by the feeble continuations of the axial ribs. Aperture large; posterior angle acute; outer lip thin, showing the external markings within; columella slender, decidedly sinuous, not reflected.

The type (Cat. no. 123025 U.S.N.M.) has the last eight whorls which measure: Length 9.4 mm., diameter 2.2 mm. It was dredged at U. S. Bureau of Fisheries station 3392, in the Gulf of Panama, in 1270 fathoms on hard bottom, temperature 36.4°.

TURBONILLA (TURBONILLA) DIEGENSIS, new species.

Plate 2, fig. 13, 13*a*.

Shell small, subdiaphanous to dingy white. Nuclear whorls two and one-half, helicoid, loosely coiled, decidedly elevated, about one-fifth immersed, having their axis at a right angle to that of the later whorls. Post-nuclear whorls, moderately rounded, somewhat overhanging, the greatest convexity being on the lower third of the exposed portion of the whorls, traversed by 14 broad, coarse and strong, oblique, and somewhat flexuous axial ribs on the fourth and seventh whorl and 18 on the eighth. These ribs extend over the angulated periphery to the umbilical region, appearing fainter on the base; the deep intercostal grooves terminate at the periphery, i. e., do not appear on the base as gouged out spaces, as they do posterior to the periphery, but simply as plain shallow grooves between the ribs formed by the raising of these above the general surface of the shell. The whorls slope rapidly toward the suture and are somewhat contracted and shouldered at the summit, thus marking a prominent subchanneled suture. Aperture large, broadly ovate, showing the axial ribs within; outer lip thin, subpatulous, shortly curved to meet the short, somewhat revolute, slightly twisted, columella.

The type figured has ten post-nuclear whorls, and measures: Length 5.3 mm., diameter 1.7 mm. It comes from San Diego, California, and forms Cat. no. 130316, U.S.N.M. Cat. no. 10916, U.S.N.M., has two specimens from the same locality, while Cat. no. 163217, U.S.N.M., covers seventeen individuals from San Pedro, California. About twenty from the same place were identified for Mrs. Oldroyd. Cat. no. 195334, U.S.N.M., seven specimens from San Diego, California. Three individuals were dredged by the University of California, off San Diego, California.

TURBONILLA (TURBONILLA) ACRA, new species.

Plate 2, fig. 14.

Shell very long and slender, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls high between the sutures, varying in outline, the first to eleventh being flattened, almost cylindric, with very strongly shouldered summits, the rest moderately well rounded, with less strongly shouldered summits. Axial ribs very strong on the first 11 whorls, less so and more rounded on the remaining. There are about 14 upon each of the first eleven turns, 22 upon the twelfth, 20 upon the thirteenth, fourteenth, and fifteenth, and about 30 much enfeebled and irregular ones upon the last turn, where they pass over the well-rounded periphery and base to the umbilical region. On the early turns the axial ribs terminate as strong, exserted cusps at the summit; on the last turns they are merely rounded. Early sutures strongly marked, later ones well impressed. Aperture ovate, posterior angle acute; outer lip thin; columella slender, almost straight, obliquely inserted.

The type (Cat. no. 206848 U.S.N.M.) has seventeen whorls, and measures: Length 10 mm., diameter 1.8 mm. It was collected off Catalina Island, California.

TURBONILLA (TURBONILLA) LUCANA, new species.

Plate 2, fig. 3.

Shell elongate-conic, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, slightly excurved at the summit, weakly shouldered, marked by slender, sinuous, retractive axial ribs, of which 20 occur upon the third, 22 upon the fourth and fifth, 26 upon the sixth and seventh, and 30 upon the penultimate whorl. Intercostal spaces a little narrower than the ribs, shallow, the depressed portion terminating at the periphery. Sutures well marked. Base moderately long, marked by the slender continuations of the axial ribs, which extend to the umbilical area. Aperture oval; posterior angle acute; outer lip thin, showing the external markings within; columella moderately strong, curved, reënforced by the attenuated base for two-thirds of its length and provided with a weak fold at its insertion.

The type (Cat. no. 4103, U.S.N.M.) was collected by J. Xantus at Cape St. Lucas, Lower California. It has nine post-nuclear whorls, which measure: Length 6 mm., diameter 1.5 mm.

TURBONILLA (TURBONILLA) PROLONGATA Carpenter.

Plate 2, fig. 18.

Chemnitzia prolongata CARPENTER, Cat. Mazatlan Shells, 1856, p. 429.

Shell small, very slender, bluish-white. Nuclear whorls small, two, forming a moderately elevated, helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is one-third immersed. Post-nuclear whorls almost flat, rather high between the sutures, slightly contracted at the suture, and weakly shouldered at the summit, marked by well-rounded, slender, protractive axial ribs, of which 12 occur upon the first to fourth, 14 upon the fifth, 16 upon the sixth, 20 upon the seventh and eighth, 22 upon the ninth and the penultimate turn. Intercostal spaces not quite as wide as the ribs. Sutures well impressed, rendered slightly wavy by the axial ribs. Periphery of the last whorl well rounded. Base rather long, well rounded, marked by the continuation of the axial ribs, which extend to the slight umbilical chink. Aperture rather large, oval; somewhat expanded anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, somewhat revolute; parietal wall covered by a faint callus.

The type is on tablet 1995, Liverpool collection, in the British Museum, and comes from Mazatlan, Mexico, It has eleven post-nuclear whorls and measures: Length 5.37 mm., diameter 1.25 mm.

Subgenus CHEMNITZIA D'Orbigny.

Chemnitzia D'ORBIGNY, Hist. Nat. Iles Canaries, 1839, p. 77; + *Euturbonilla* SEMPER (part), Archiv. Nat. Fr. Meck., 1861, pp. 354–361; no type; + *Microbeliscus* SANDBERGER, Land u. Süssw. Conch. d. Vorwelt, 1874, p. 690; type, *Turbonilla* (*Microbeliscus*) *inaspectus* Fuchs.

Turbonillas without spiral sculpture, having prominent axial ribs which fuse or terminate at the periphery. The intercostal spaces are deep and sunken and terminate at or a little above the periphery, extending upward to the summits of the whorls. Base smooth, devoid of all sculpture. Columella straight. All our West American species belonging to this group are small, slender forms of semitranslucent bluish-white to milk-white color.

Type.—*Melania campanellæ* Philippi.

KEY TO THE SPECIES OF THE SUBGENUS CHEMNITZIA.

Adult shell more than 7 mm. long.
    Whorls well rounded..*hypolispa*, p. 34.
    Whorls flattened..*gabbiana*, p. 35.
Adult shell less than 7 mm. long.
    Summit of the whorls tabulated.
        Whorls strongly contracted at the suture..................*æpynota*, p. 35.
        Whorls only slightly contracted at the suture...............*muricata*, p. 36.

Adult shell less than 7 mm. long—Continued.
Summit of the whorls not tabulated.
Intercostal spaces terminating a little posterior to the suture.
Whorls slopingly shouldered, summit appressed....... *santarosana*, p. 36.
Whorls narrowly squarely shouldered, summit not appressed *paramœa*, p. 37.
Intercostal spaces not terminating posterior to the suture.
Axial ribs strongly protractive.......................... *houseri*, p. 37.
Axial ribs not strongly protractive.
Shell very slender, acicular.......................... *aculeus*, p. 38.
Shell conic.
Whorls narrowly equally shouldered at the summit.
Axial ribs vertical..................... *muricatoides*, p. 38.
Axial ribs protractive, sinuous .... *kelseyi*, p. 39.
Whorls almost appressed at the summits........ *raymondi*, p. 39.

TURBONILLA (CHEMNITZIA) HYPOLISPA, new species.

Plate 2, figs. 5, 5*a*.

Shell broadly conic, yellowish-white. Nuclear whorls very small, two and one-half, forming a rather elevated helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is a little more than half immersed. Post-nuclear whorls well rounded, slightly shouldered at summit, marked by very strong, sublamellar, protractive axial ribs, of which 14 occur upon the second and third, 16 upon the fourth to eighth, 18 upon the ninth and tenth, 20 upon the eleventh, 24 upon the twelfth, and 25 upon the penultimate turn. On the early whorls these ribs are very strong in the middle, bending suddenly toward the summit, which gives them a decidedly angulated appearance a little below their termination; on the last three whorls they are more closely crowded and less strongly developed. Intercostal spaces about one and one-half times as wide as the ribs on the early whorls; on the last three they are about equal to them, well impressed, terminating a little above the sutures. Sutures well marked. Periphery of the last whorl slightly angulated. Base short, well rounded. Aperture rhomboidal; columella slender, somewhat curved, and slightly reflected.

The two cotypes (Cat. no. 206851, U.S.N.M.) were dredged by the University of California at station 43, off San Diego, California. One of these is a young specimen with the nucleus; the other has the last eleven whorls and measures: Length 8.1 mm., diameter 2 mm.

The University of California has another specimen from the same lot (Cat. no. 206852, U.S.N.M.), one specimen from San Diego. Cat. no. 205940, U.S.N.M., one specimen dredged by the University of California, at station 32, off Catalina Island; also two specimens dredged at stations 47 and 73, off San Diego.

TURBONILLA (CHEMNITZIA?) GABBIANA Cooper.

Chemnitzia gabbiana Cooper, Am. Journ. Conch., vol. 6, 1870, p. 66=*Turbonilla gracillima* Gabb, Proc. Cal. Acad. Sci., 1865, p. 186; not *Chemnitzia gracillima* Carpenter, Cat. Maz. Shells, 1856, p. 431; +*Turbonilla* (*Chemnitzia?*) *montereyensis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 494-5.

Mr. Gabb's description is as follows:

> Shell small, very slender, long, white; vertex broken; whorls eleven or more, flattened on the sides; sutures strongly impressed, ribs about 23, large, obtuse, running from the suture to the margin of the base; base convexly truncated, smooth; aperture subcircular; columella thick. Length 10 mm., diameter 3.3 mm.
>
> Habitat, Monterey, California; Dr. J. G. Cooper, collector. This shell can be readily distinguished by its extremely slender form and the strong, slightly oblique ribs.

The type, according to Mr. Gabb, is in the collection of the California Geological Survey,[a] but appears to have been misplaced or lost. From the description we are led to believe that it is a form similar to *T. torquata*, but of considerably broader spire.

TURBONILLA (CHEMNITZIA) ÆPYNOTA, new species.

Plate 2, figs. 10, 10*a*.

Shell small, elongate-conic diaphanous. Nuclear whorls two and one-half, small, helicoid, forming a moderately elevated spire, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fifth immersed. Post-nuclear whorls high between the sutures, very strongly shouldered at the summits, somewhat contracted at the periphery, well rounded, marked by strong, sublamellar axial ribs that render the summits strongly crenulate. Sixteen of the axial ribs appear upon the first and second, 18 upon the third, fourth, and fifth, and 20 upon the remaining turns. Intercostal spaces a little wider than the ribs, deeply sunk below the general surface, extending to the suture on all the turns of the spire. Sutures strongly marked. Periphery of the last whorl feebly angulated. Base short, well rounded, smooth. Aperture rather large, subquadrate, posterior angle obtuse; outer lip thin, bent abruptly anteriorly toward the columella, which it joins almost at right angles; columella very slender and gently curved.

The type (Cat. no. 162443, U.S.N.M) has eight post-nuclear whorls and measures: Length 3.2 mm., diameter 0.9 mm. It was collected by Mr. F. W. Kelsey, in 30 fathoms, off San Martin Island, Lower California. Three additional specimens (Cat. no. 163242, U.S.N.M.) were collected by Mrs. Oldroyd, at San Pedro, California.

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[a] Proc. Cal. Acad. Sci., 1865, p. 183.

TURBONILLA (CHEMNITZIA) MURICATA Carpenter

Plate 2, fig. 9.

Chemnitzia muricata CARPENTER, Cat. Maz. Shell, 1856, p. 428.

Shell elongate-conic, milk-white. Nuclear whorls three, forming an elevated helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is almost half immersed. Post-nuclear whorls moderately rounded, somewhat contracted at the suture, strongly shouldered at the summit, marked by very strong, slightly protractive axial ribs, of which 14 occur upon the first to fourth and 16 upon the remaining turns. These ribs extend prominently to the summit which they render muricated. Intercostal spaces as wide as the ribs, deeply impressed, terminating at the periphery. Sutures very strongly marked. Periphery and base of the last whorl well rounded, smooth. Aperture rhomboidal; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, slightly twisted and curved.

The type and four specimens were taken from *Spondylus* at Mazatlan, Mexico. The type and one other specimen are on tablet 1993, Liverpool collection, British Museum. It has seven post-nuclear whorls and measures: Length 2.3 mm., diameter 0.7 mm.

This shell, as far as the structure of the spire is concerned, strangely recalls *Turbonilla* (*Asmunda*) *turrita* of C. B. Adams. The base, however, is entirely different.

TURBONILLA (CHEMNITZIA) SANTAROSANA, new species.

Plate 2, figs. 7, 7*a*.

Shell small, delicate, subdiaphanous to milk-white. Nuclear whorls two and one-half, forming a moderately elevated helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is very slightly immersed. Post-nuclear whorls well rounded, slopingly shouldered near the summit, slightly constricted at the suture, marked by broad, low, rounded, axial ribs, which become somewhat flattened at the summit. Of these 16 occur upon the first to fourth, 18 upon the fifth and sixth, while upon the penultimate they are very much enfeebled and ill-defined. Intercostal spaces narrow, shallow, the depressed area terminating a little posterior to the suture. Sutures constricted. Periphery and base of the last whorl somewhat inflated. Aperture moderately large, rhomboidal; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella very thin and strongly curved.

The type and five specimens (Cat. no. 163239, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2902, in 53 fathoms, temperature 45°, off Santa Rosa Island, California. The type has eight and one-half post-nuclear whorls and measures: Length 4.5 mm., diameter 1.4 mm. Six specimens (Cat. no. 163240, U.S.N.M), were dredged at U. S. Bureau of Fisheries station 2901 in 48 fathoms, temperature 55°.1, off Santa Rosa Island. Four specimens were obtained by the University of California, at station 81, off San Diego, and another individual at station 19, off Newport, California.

TURBONILLA (CHEMNITZIA) PARAMŒA, new name.

Plate 2, figs. 4, 4*a*.

Chemnitzia similis C. B. ADAMS, Ann. Lyc. of Nat. Hist. N. Y., vol. 5, 1852, pp. 392-393.

Shell elongate-conic, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls strongly rounded, roundly shouldered at the summit, marked by moderately strong, rounded, protractive axial ribs, of which 16 occur upon the first, 18 upon the second and third, 20 upon the fourth to seventh, 22 upon the eighth and the penultimate whorl. Intercostal spaces a little wider than the ribs, terminating a little above the sutures. Sutures constricted. Periphery and the short base of the last whorl well rounded. Aperture (defective); columella stout, somewhat sinuous.

The above description is based upon Professor Adams's type, which has lost the nucleus and early whorls. The ten remaining measure: Length 5.9 mm., diameter 1.5 mm. It comes from Panama.

This species resembles *Turbonilla* (*Strioturbonilla*) *panamensis* C. B. Adams, but differs in having the whorls more rounded, fewer and less strongly developed ribs and more constricted sutures.

TURBONILLA (CHEMNITZIA) HOUSERI, new species.

Plate 2, figs. 15, 15*a*.

Shell small, elongate-conic, milk-white. Nuclear whorls two and one-fourth, forming an elevated helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls strongly rounded, slightly shouldered at the summit, marked by strong, sublamellar, decidedly protractive axial ribs, which are so arranged as to practically form continuous oblique lines, from whorl to whorl. Of these ribs 14 appear upon the first to third, 16 upon the fourth and fifth, and 18 upon the remaining whorls. Intercostal spaces about as wide as the ribs, deeply impressed. Sutures somewhat constricted. Periphery of the last whorl and base well rounded. Aperture rhomboidal; outer lip thin, columella moderately strong, slightly curved and slightly reflected.

The two cotypes (Cat. no. 206853, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2813, in 40 fathoms, bottom temperature 81°, on coral sand bottom, off Galapagos Islands. One of these is a young individual from which our description of the nucleus and early whorls was taken. The other has lost the nucleus, the nine remaining whorls measure: Length 3.7 mm., diameter 1.1 mm.

Named for Prof. G. L. Houser.

TURBONILLA (CHEMNITZIA) ACULEUS C. B. Adams.

Plate 2, figs. 2, *2a*.

Chemnitzia aculeus C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., vol. 5, 1852, p. 388.

Shell very slender, elongate-conic, subdiaphanous to milk-white. Nuclear whorls small, two and one-half, forming a small elevated helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls slightly rounded, weakly shouldered at the summit, marked by low, rounded, somewhat sinuous, protractive axial ribs, of which 14 occur upon the first to third, 16 upon the fourth and fifth, 18 upon the sixth to eighth, 20 upon the ninth, 22 upon the tenth, and 25 upon the penultimate turn. Intercostal spaces about as wide as the ribs, well impressed, terminating at the sutures. Sutures well marked. Periphery and base of the last whorl well rounded, smooth, excepting faint lines of growth. Aperture small, rhomboidal; outer lip thin, showing the external markings within; columella oblique, almost straight, strongly reënforced by the base.

The above description is based upon Professor Adams's types; one a young specimen, of six and one-half whorls, has a little more perfect nucleus than the adult shell; the latter has twelve post-nuclear whorls and measures: Length 4.4 mm., diameter 1 mm. They come from Panama.

TURBONILLA (CHEMNITZIA) MURICATOIDES Dall and Bartsch.

Plate 2, figs. 11, *11a*.

Turbonilla (*Chemnitzia*) *muricatoides* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 495, pl. 14, figs. 2, *2a*.

Shell small, slender, subdiaphanous to milk white; nuclear whorls two and one-half, helicoid but slightly elevated, well rounded, having their axis at right angles to the axis of the post-nuclear turn. Post-nuclear whorls smooth, rather high between the sutures, moderately rounded, marked by strong sublamellar axial ribs, which are about half as wide as the spaces that separate them, and extend strongly to the very summit of the whorl where they render the well-marked sutures crenulate. There are 14 of these ribs upon the first, 18 upon the fifth, and 20 upon the penultimate turn. The depressed intercostal spaces terminate abruptly at the periphery. Base of the last whorl well rounded, smooth, without sculpture. Aperture: (outer lip fractured), columella slender, slightly twisted.

The type has seven post-nuclear turns and measures: Length 3 mm., diameter 1 mm. It is Cat. no. 195942, U.S.N.M., and comes from Monterey, California. Another specimen (Cat. no. 160488, U.S.N.M.) was collected by Doctor Dall at the same place.

TURBONILLA (CHEMNITZIA) KELSEYI, new species.

Plate 2, figs. 16, 16*a*.

Shell small, semitransparent. Nuclear whorls small, two and one-fourth, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fifth immersed. Post-nuclear whorls moderately rounded, ornamented by somewhat sinuous, slightly protractive, rounded axial ribs, which are lower and somewhat expanded at the slightly shouldered summits of the whorls; 14 of these appear upon the third, 16 upon the fourth, 18 upon the fifth, 20 upon the sixth and seventh, 22 upon the eighth, and 24 upon the penultimate post-nuclear whorl of the type. Intercostal spaces only moderately impressed, about as wide as the ribs. Sutures well impressed. Periphery of the last whorl well rounded. Base moderately long, well rounded. Aperture suboval, posterior angle obtuse; outer lip thin, showing the external sculpture within; columella short, stout, twisted, provided with a weak fold at its insertion.

The type (Cat. no. 46506, U.S.N.M.) comes from San Diego, California. It has lost the nucleus and probably the first two post-nuclear turns, and measures: Length 4.7 mm., diameter 0.9 mm. The nuclear whorls were described from a specimen of lot Cat. no. 56789, U.S.N.M.

The following specimens have been examined:

U.S.N.M. Cat. no.	No. of specimens.	Depth, fathoms.	Locality.	Disposition of material.
56789	3	....	Santa Barbara, California........................	U. S. Nat. Mus.
152197	22	....	San Pedro, California............................	Do.
152314	2	10	Ocean Beach, San Diego, California............	Do.
60916	2	....	San Diego, California............................	Do.
162435	1	....	Pacific Beach, San Diego, California...........	Do.
46503	2	....	Todos Santos Bay, Lower California...........	Do.
106513	2	....	Point Abreojos, Lower California..............	Do.
162432	1	....	San Ignacio, Lower California..................	Do.

Named for Prof. F. W. Kelsey.

TURBONILLA (CHEMNITZIA) RAYMONDI, new species.

Plate 2, figs. 17, 17*a*.

Shell acicular, milk-white. Nuclear whorls small, two and one-half, forming a low, helicoid spire, the axis of which is almost at right angles to that of the succeeding turns, in the first of which the nuclear spire is about one-fifth immersed. Post-nuclear whorls well rounded, increasing very regularly in size, high between the sutures, almost appressed at the summit and ornamented by well-developed, rounded, axial ribs, of which there are 16 upon the second and third, 18 upon the fourth, 20 upon the fifth to eighth, 22 upon the ninth and penultimate whorls. Intercostal spaces deep, about one and one-half times as wide as the ribs. Sutures strongly impressed, rendered slightly wavy by the ribs. Periphery of the last whorl angulated. Base short, well rounded. Aperture subquadrate. Columella short, slightly curved and somewhat oblique.

The type (Cat. no. 206849, U.S.N.M.) was dredged off Catalina Island. It has eleven postnuclear whorls and measures: Length 6.2 mm., diameter 1.6 mm. Another specimen from the same locality is in the University of California, which also has a specimen dredged off San Diego. Cat. no. 163252a, U.S.N.M., contains a specimen dredged at U. S. Bureau of Fisheries station 2901, off Santa Rosa Island, in 48 fathoms. Cat. no. 206850, U.S.N.M., contains another specimen from San Diego, California.

Named for Prof. William J. Raymond.

Subgenus STRIOTURBONILLA Sacco.

Strioturbonilla SACCO, I Moll. del Piemonte e della Liguria, 1892, p. 94.

Shell as in *Turbonilla* and *Chemnitzia* but finely and closely spirally striated on the spire and base.

Type.—*Strioturbonilla alpina* Sacco.

All our West American species, with the exception of *T. affinis* and *T. smithsoni*, are of blueish-white to milk-white color; the two exceptions being of a yellowish cast.

KEY TO THE SPECIES OF THE SUBGENUS STRIOTURBONILLA.

Spiral striations extending uniformly over the axial ribs and intercostal spaces between the sutures.
  Intercostal spaces terminating posterior to the periphery, having a plain, smooth band in the suture.
    Intercostal spaces pinched in to form a step immediately below the summit .... *stephanogyra*, p. 42.
    Intercostal spaces not pinched in at the summit.
      Axial ribs exceedingly protractive.
        Axial ribs straight .... *panamensis*, p. 42.
        Axial ribs sinuous .... *buttoni*, p. 43.
      Axial ribs moderately protractive.
        Whorls overhanging.
          Axial ribs 10–18 .... *vancouverensis*, p. 44.
          Axial ribs 14–22 .... *asser*, p. 45.

- Spiral striations extending uniformly over the axial ribs and intercostal spaces between the sutures—Continued.
  - Intercostal spaces terminating posterior to the periphery, having a plain, smooth band in the suture—Continued.
    - Intercostal spaces not pinched in at the summit—Continued.
      - Axial ribs moderately protractive—Continued.
        - Whorls not overhanging.
          - Intercostal spaces 4 times as wide as the ribs....*mexicana*, p. 45.
          - Intercostal spaces less than 3 times as wide as the ribs.
            - All post-nuclear whorls well rounded.
              - Axial ribs poorly developed...............*attrita*, p. 46.
              - Axial ribs well developed.
                - Spiral striations strong...............*nicholsi*, p. 46.
                - Spiral striations microscopic.
                  - Axial ribs 16–22...............*torquata*, p. 47.
                  - Axial ribs 16–28...............*stylina*, p. 48.
            - Early post-nuclear whorls well rounded, later ones flattened...................................*calvini*, p. 48.
      - Axial ribs vertical or nearly so.
        - Axial ribs much enfeebled on the last whorl........*carpenteri*, p. 49.
        - Axial ribs strong upon all the whorls.
          - Axial ribs 16...................................*simpsoni*, p. 49.
          - Axial ribs 16–22...........................*profundicola*, p. 50.
    - Intercostal spaces extending to the suture.
      - Shell very robust...*galianoi*, p. 51.
      - Shell not robust.
        - Shell broadly conic.
          - Shell large, length 6 mm......................*humerosa*, p. 52.
          - Shell small, length less than 4 mm ....*c—b—adamsi*, p. 52.
        - Shell slender.
          - Axial ribs extending over the base................*serræ*, p. 53.
          - Axial ribs not extending over the base.
            - Axial ribs 14–21..............................*aresta*, p. 54.
            - Axial ribs 14–16.............................*pazana*, p. 54.
- Spiral striations confined to the intercostal spaces between the sutures.
  - Spiral striations only two between the sutures................*galapagensis*, p. 55.
  - Spiral striations more than two between the sutures.
    - Intercostal spaces uniformly spirally striated..................*undata*, p. 55.
    - Intercostal spaces not uniformly spirally striated.
      - Intercostal spaces marked by a peripheral line of pits and numerous striations.
        - Intercostal spaces less wide than the ribs...............*affinis*, p. 56.
        - Intercostal spaces wider than the ribs.
          - Spiral striations between the sutures 16..........*phanea*, p. 56.
          - Spiral striations between the sutures 24........*imperialis*, p. 57.
      - Intercostal spaces marked by a peripheral and a submedian line of pits and numerous fine striations.
        - Fine striations between median pits and summit 40..*smithsoni*, p. 57.
        - Fine striations between median pits and summit 20...*gracilior*, p. 58.

TURBONILLA (STRIOTURBONILLA) STEPHANOGYRA, new species.

Plate 3, figs. 8, 8*a*.

Shell elongate-conic, milk-white. Nuclear whorls three, forming a well-elevated spire, the axis of which is at right angles to that of the succeeding turns, in the first of which they are about one-fifth immersed. Post-nuclear whorls decidedly flattened, with strongly beveled shoulders, marked by strong, almost cylindrical, narrow, well rounded, vertical axial ribs, of which 14 occur upon the first to third, 16 upon the fourth to sixth, and 18 upon the remaining turns. Intercostal spaces about twice as wide as the ribs, well impressed, with a decidedly pinched-in area near the summit, which gives this part of the shell a step-like aspect. Sutures well marked. Periphery and base of the last whorl well rounded. Entire surface of spire and base marked by exceedingly fine, closely spaced, spiral striations. Aperture rhomboidal, rather long; outer lip thin, showing the external sculpture within; columella slender, almost straight.

The type (Cat. no. 162440 U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2799, in 29½ fathoms, in the bay of Panama. It has ten post-nuclear whorls, and measures: Length 4.8 mm., diameter 1.3 mm.

TURBONILLA (STRIOTURBONILLA) PANAMENSIS C. B. Adams.

Plate 3, figs. 12, 12*a*.

Chemnitzia panamensis C. B. Adams, Ann. Lyc. Nat. Hist. of N. Y., vol. 5, 1852, p. 392.

Shell with the sides of the spire forming a straight line, light yellow. Nuclear whorls small, two and two-thirds, forming a quite elevated spire, the axis of which is at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Post-nuclear whorls rather low between the sutures, decidedly flattened and slightly shouldered at the summit, marked by strong, rounded, very protractive axial ribs, which are of equal strength from the summit to the periphery, of these 16 occur upon the first seven whorls, 18 upon the eighth, 20 upon the ninth, 22 upon the tenth, and 25 upon the penultimate turn. Intercostal spaces about as wide as the ribs, terminating a little above the sutures. Sutures well impressed, rendered slightly sinuous by the ribs. Periphery of the last whorl and the moderately long base, somewhat inflated and well rounded. Entire surface of base and spire marked by very fine closely spaced spiral striations. Aperture pear-shaped; posterior angle acute; outer lip thin, showing the external sculpture within; columella strong, almost straight, decidedly revolute, reënforced for half its length by the base.

The Amherst collection contains a tube with six specimens; one of these is a splendid individual which undoubtedly served Professor Adams for his diagnosis. We have used it for our description and figure. It has twelve post-nuclear whorls, and measures: Length 5.5 mm., diameter 1.5 mm. They came from Panama.

TURBONILLA (STRIOTURBONILLA) BUTTONI, new species.

Plate 3, figs. 4, *4a*.

Shell irregularly elongate-conic, yellowish-white. Nuclear whorls two, very small, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are very slightly immersed. Post-nuclear whorls slightly rounded, ornamented by very regular, rounded, somewhat sinuous, and decidedly protractive axial ribs, which extend undiminished from the summit to the periphery of the whorls and very feebly beyond this on the base. There are 16 of these ribs upon the first to third, 18 upon the fourth and fifth, 20 upon the sixth to ninth, and 22 upon the penultimate turn. Intercostal spaces well impressed, about as wide as the ribs. Sutures well marked, rendered wavy by the strong ribs. Periphery of the last whorl well rounded. Base short, well rounded. Entire surface of spire and base marked by numerous exceedingly fine wavy spiral striations. Aperture subquadrate, posterior angle obtuse; outer lip thin; columella short, moderately strong, slightly twisted and reflected, provided with a weak oblique fold at its insertion.

The type (Cat. no. 163241 U.S.N.M.) and nine specimens were collected at San Pedro, California. It has eleven post-nuclear whorls, and measures: Length 6.3 mm., diameter 1.5 mm.

The following additional specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	U.S.B.F. station.	Depth, fathoms.	Locality.
163246	1	2,901	48	Off Santa Rosa Island, California.
56867	2			Do.
205938	2			San Pedro, California.
205939	12			Do.
203245*a*	5			Do.
Berry coll	2			Do.
160491	2			San Diego, California.
152314*a*	1			Do.
Delos Arnold coll	2			Do.
162436	1			Catalina Island, California.
106513	3			Point Abreojos, Lower California.
56358	2			Todos Santos Bay, Lower California.
46503	3			Do.

Named for Fred L. Button.

TURBONILLA (STRIOTURBONILLA) VANCOUVERENSIS Baird.

Plate 4, fig. 9.

Chemnitzia vancouverensis BAIRD, Proc. Zool. Soc., 1863, p. 67. *Turbonilla* (*Strioturbonilla*) *vancouverensis* (BAIRD), DALL, and BARTSCH, Proc. U. S. Nat. Mus., vol. 30, 1907, pp. 495–496, pl. 44, fig. 1.

Shell solid, rather broad and stout, subdiaphanous, bluish to milk-white. Nuclear whorls two, large, helicoid, partly obliquely immersed in the first of the later turns. Post-nuclear whorls well rounded, with the greatest convexity on the lower half of the exposed portion; ornamented by about 10 very broad, strong, slightly protractive axial ribs on the second, 14 on the fifth, 16 on the eighth, and 18 on the penultimate whorl. These ribs terminate before they reach the periphery of the whorl, leaving a plain band above the suture, as in *T. torquata* Gould, but not as broad as in that species. Intercostal spaces deep, narrower than the ribs. Sutures well marked by the shouldering at the summit and the sudden sloping of the ribs just above the periphery of the whorls. Aperture subovate; lip thin, joining the short, somewhat revolute columella in an even curve. Entire surface marked by faint, wavy, spiral striations. The specimen figured has 10 post-nuclear whorls, and measures: Length, 6 mm.; diameter, 1.8 mm.

Another specimen from the same locality, which has 12 post-nuclear whorls but is minus the nucleus and probably the first of the succeeding turns, measures: Length, 9.2 mm.; diameter, 2.5 mm.

This species resembles *T. torquata* Gould, but can easily be distinguished from it by its broader base, its large, partly immersed, slanting nucleus, and the robust character of its whorls and ribs, the latter being fewer and much broader; the intercostal spaces being comparatively narrower. Baird's cotypes, three specimens, were taken from the crop of a pintail duck shot in Esquimalt Harbor, Vancouver Island, British Columbia; they are in the British Museum.

The following specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	Locality.	Depth, fathoms.	Collector.	Disposition of material.
169489	2	Kadiak Island, Alaska	13	W. H. Dall	U. S. Nat. Mus.
160490	1	Lituya Bay, Alaska	8	do	Do.
160993	1	Port Etches, Alaska		do	Do.
126670	4	Victoria, Vancouver Island, British Colombia.		C. F. Newcombe	Do.
44938	1	Puget Sound, Washington		C. B. Kennerley	Do.
196184	1	Carter Bay, British Columbia.		G. W. Taylor.	Do.
	1	do		do	Taylor coll.
196183	3	Port Simpson, British Columbia.		do	U. S. Nat. Mus.
	11	do		do	Taylor coll.
	2	West of Rose Spit, Queen Charlotte Island, British Columbia.		do	Do.
	1	Alert Bay, British Columbia.		do	Do.
	20	Departure Bay, British Columbia.		do	Do.
196185	5	do		do	U. S. Nat. Mus.

TURBONILLA (STRIOTURBONILLA) ASSER, new species.

Plate 3, figs. 1, 1*a*.

Shell elongate-conic, milk-white. Nuclear whorls small, two, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-third immersed. Post-nuclear whorls well rounded, slightly overhanging, ornamented by well developed, somewhat sinuous, rounded, protractive axial ribs, of which there are about 14 upon the third, 16 upon the fourth and fifth, 18 upon the sixth to eighth, 20 upon the ninth to eleventh, and 22 upon the twelfth and penultimate turns. Intercostal spaces almost equal to the ribs in width, shallow, terminating some little distance posterior to the summit of the succeeding whorl, thus leaving a rather broad, plain band above the suture in each turn. Sutures strongly constricted. Periphery of the last whorl well rounded. Base short, well rounded. Entire surface of spire and base marked by very fine, closely spaced, spiral striations. Aperture subquadrate. Posterior angle obtuse, outer lip thin, showing the external markings within, columella slender, well curved and slightly revolute.

The type and a young specimen (Cat. no. 205932, U.S.N.M.) from which the nucleus has been described, come from off Redondo, California. The type has lost the nucleus and first post-nuclear whorl. The thirteen remaining whorls measure: Length, 8.3 mm.; diameter, 1.9 mm. Two additional specimens (Cat. no. 205933, U.S.N.M.) come from San Pedro, California. Two more (Cat. no. 163244, U.S.N.M.) are also from the same locality.

TURBONILLA (STRIOTURBONILLA) MEXICANA, new species.

Plate 3, figs. 5, 5*a*.

Shell broadly conic, yellowish-white. Nuclear whorls two and one-half, forming a decidedly elevated helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is slightly immersed. Post-nuclear whorls well rounded, appressed at the summit, marked by slender protractive axial ribs, of which 16 occur upon the first and second, 14 upon the third and fourth, and 16 upon the remaining whorls. Intercostal spaces well impressed, at least four times as wide as the ribs, terminating a little distance posterior to the suture, marked by many very fine, closely spaced spiral striations, which do not appear to extend over the ribs. Sutures well impressed. Periphery of the last whorl somewhat angulated. Base short, well rounded, marked only by exceedingly fine, spiral striations. Aperture large, subquadrate, posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, slightly curved and somewhat revolute.

The type (Cat. no. 162515, U.S.N.M.) and three additional specimens were dredged at U. S. Bureau of Fisheries station 2830, in 66 fathoms, temperature 74°.1, off Lower California. The type is not quite mature; it has nine post-nuclear whorls, and measures: Length, 4.5 mm.; diameter, 1.3 mm.

The following specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	U.S.B.F. station.	Locality.	Depth, fathoms.	Temperature, degrees.	Disposition of material.
162515......	4	2830	Off Lower California.......	66	74.1	U. S. Nat. Mus.
96561......	5	2830	.....do.....................	66	74.1	Do.
163253......	4	2823	Off La Paz, Lower California.	26½	....	Do.
191566......	1	2826	.....do.....................	9½	....	Do.

TURBONILLA (STRIOTURBONILLA) ATTRITA, new species.

Plate 4, figs. 11, 11*a*.

Shell slender, elongate-conic, bluish-white. Nuclear whorls small, two and one-half, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are slightly immersed. Post-nuclear whorls very high between the sutures, almost flattened, ornamented with very low, flattened, somewhat irregular, protractive axial ribs, which are best developed on the early whorls. Of these there are 18 upon the second, 22 upon the third, 18 upon the fourth and fifth, 22 upon the sixth, 18 upon the seventh, 20 upon the eighth and ninth; on the next turn they become quite enfeebled, and on the penultimate turn they are obsolete. Intercostal spaces about half as wide as the ribs and very shallow. Sutures well impressed. Periphery of the last whorl well rounded. Base short, somewhat inflated. Entire surface of the spire and base marked by numerous very fine, wavy spiral striations. Aperture broadly oval; posterior angle acute; outer lip thin; columella short, slender, somewhat curved, and slightly reflected.

The type and six individuals (Cat. no. 163248, U.S.N.M.) come from San Pedro, California. The type has twelve post-nuclear whorls and measures: Length 7.4 mm., diameter 1.6 mm. Cat. no. 163243, U.S.N.M., contains five specimens from San Pedro, California. Another specimen (Cat. no. 152314, U.S.N.M) comes from San Diego, California. Another specimen in Mr. Berry's collection is from Long Beach, California.

TURBONILLA (STRIOTURBONILLA) NICHOLSI, new species.

Plate 3, fig. 2.

Shell large and robust, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, slightly shouldered at the summit, marked by strong, somewhat sinuous, decidedly protractive axial ribs, of which 14 occur upon the first, 16 upon the second to sixth, 18 upon the seventh, 20 upon the eighth, 22 upon the ninth, and 25 upon the penultimate turn. Intercostal spaces almost as wide as the ribs, well impressed, terminating a little distance posterior to the suture. Sutures strongly marked. Periphery and rather long base of the last whorl well rounded, marked by the feeble continuations of the axial ribs. Entire surface of base and spire marked by numerous, strongly incised spiral striations, of which those on the spire somewhat exceed the ones on the base in strength. Aperture large, oval; outer lip thin, showing the external sculpture within; columella slender, sigmoid, slightly reflected.

The type (Cat. no. 160210, U.S.N.M.) was collected by Lieutenant Nichols in the Gulf of California. It has lost the nucleus. The twelve remaining whorls measure: Length 8.8 mm., diameter 2.4 mm.

TURBONILLA (STRIOTURBONILLA) TORQUATA Gould.

Plate 4, figs. 15, 15*a*.

Chemnitzia torquata GOULD, Bost. Journ. Nat. Hist., vol. 4, 1852, p. 384, pl. 14, fig. 16; not *Turbonilla* (*Strioturbonilla*) *torquata* (GOULD) DALL and BARTSCH, Mem. Cal. Acad. Sci., vol. 3, 1903, pp. 271, 272, pl. 2, figs. 4, 4a, which may take the name *Turbonilla* (*Strioturbonilla*) *ralphi* DALL and BARTSCH.

Shell robust, bluish-white. Nuclear whorls small, two, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fifth immersed. Postnuclear whorls well rounded, ornamented by strongly elevated, slightly protractive axial ribs, of which 16 occur upon all of the whorls except the penultimate, which has 22. Intercostal spaces about twice as wide as the ribs, terminating a little above the summit of the preceding whorl, thus leaving a narrow, plain band in the suture. Sutures strongly impressed. Periphery of the last whorl well rounded. Base moderately long, well rounded. Entire surface of spire and base crossed by numerous very fine, closely spaced, wavy, spiral striations. Aperture suboval, outer lip thin, showing the external sculpture within. Columella slender, decidedly curved, and somewhat reflected.

The specimen described and figured (Cat. no. 205934, U.S.N.M.) has lost the nucleus. The eleven remaining whorls measure: Length 6.5 mm., diameter 2.1 mm., and comes from off Point Firmin, California. Another specimen (Cat. no. 60916, U.S.N.M.) comes from San Diego, California. Still another (Cat. no. 205935, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 4322, in 110 to 197 fathoms, off La Jolla, California. Two additional specimens in the University of California collection were obtained at their stations 22 and 28 off San Diego. Mr. Berry's collection contains two specimens dredged in 40 fathoms off Catalina Island, California.

The type (Cat. no. 162515, U.S.N.M.) and three add
mens were dredged at U. S. Bureau of Fisheries sta
fathoms, temperature 74°.1, off Lower California.
quite mature; it has nine post-nuclear whorls, and
4.5 mm.; diameter, 1.3 mm.

Hist., 3d ser.,
ylina Dall and
part. *Turbonilla*
Nat. Mus., vol. 33,

The following specimens have been exam

U.S.N.M. cat. no.	No. of specimens.	U. S. B. F. station.	Locality.
162515......	4	2830	Off Lower C
96561......	5	2830	.....do...
163253......	4	2823	Off La P nia.
191566......	1	2826	.....d

TURBONILLA (S

uclear whorls two,
beyond the outline of
ngles to the axis of the
well rounded, separated by
gh, ornamented by rather low,
e axial ribs, of which there are 16
th, and 28 upon the penultimate turn.
ately depressed, about as wide as the ribs, ter-
distance above the sutures, thus leaving a narrow,
between the termination of the ribs and the suture as in
Shell slender, elo *Turbonilla torquata* Gould, but not quite as wide as in that
two and one-half periphery of the last whorl well rounded. Base rather
angles to that rounded. Entire surface marked by very fine, wavy spiral
slightly imm well rounded. Aperture subovate, outer lip thin; columella slender,
sutures, al long, slightly twisted, almost vertical. The specimen
somewha moderately described and figured (Cat. no. 56429, U.S.N.M.) was collected by
on the Doctor Dall in 8 or 10 fathoms at Monterey, California. It has 11
the th post-nuclear whorls and measures: Length 6.5 mm., diameter 1.7 mm.
seve (not 8 and 1.9 mm., as erroneously stated in the last-cited reference).
qu Another specimen was dredged in 12 fathoms off Del Monte, Monterey,
c by Mr. S. S. Berry (Cat. no. 165199, U.S.N.M.). Two specimens (Cat.
no. 163249, U.S.N.M.), both immature, dredged by the Bureau of
Fisheries steamer *Albatross* at station 2932 in 50 fathoms off Coronado Island, are provisionally referred to this form.

TURBONILLA (STRIOTURBONILLA) CALVINI, new species.

Plate 4, figs. 1, 1*a*.

Shell elongate-conic, milk-white. Nuclear whorls two and three-fourths, forming a decidedly elevated helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Early post-nuclear whorls strongly rounded, decidedly shouldered at the summit, and constricted at the sutures. Later ones flattened in the middle, less shouldered and less contracted. Axial ribs strong, sublamellar, shouldered a little below the summit; 14 upon the first to ninth, 16 upon the tenth, and 18 upon the penultimate turn. Intercostal spaces about two and one-half times as wide as the ribs, well impressed, a

so on the shoulder than on the summit, which gives them
appearance at this place, terminating a little above the
s well impressed. Entire surface of base and spire
vy, spiral striations. Periphery and the moderately
st whorl well rounded. Aperture rhomboidal;
the external sculpture within; columella mod-
rved.

additional specimens (Cat. no. 162442,
e U. S. Bureau of Fisheries, at station
La Paz, Lower California. One of the
s and nine post-nuclear whorls, and measures:
ameter 0.9 mm. The other cotype consists of the
-nuclear whorls; if perfect, it would probably have
. This measures: Length 3.6 mm., diameter 1.2 mm.

ed for Prof. Samuel Calvin.

TURBONILLA (STRIOTURBONILLA) CARPENTERI, new species.

Plate 3, figs. 9, 9*a*.

Shell long, slender, bluish-white. Nuclear whorls small, two and one-half depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fifth immersed. Post-nuclear whorls exceedingly high between the sutures, evenly rounded, marked by almost vertical axial ribs, which become slightly expanded and flattened at the summits. There are 18 of these ribs upon the first to third, 20 upon the fourth to sixth, 22 upon the seventh, 24 upon the eighth and ninth, and 26 upon the tenth. Upon the penultimate turn they become decidedly irregular and enfeebled. Intercostal spaces about one-half as wide as the ribs, but little depressed below the general surface of the shell. Sutures somewhat constricted. Periphery of the last whorl well rounded. Base short and somewhat inflated, marked by feeble extensions of the axial ribs. Entire surface of spire and base crossed by numerous fine, wavy, spiral striations. Aperture subquadrate, rather elongated, posterior angle obtuse, outer lip thin; columella rather long, slender, slightly sinuous.

The type (Cat. no. 160065, U.S.N.M.) has twelve post-nuclear whorls, and measures: Length 7.9 mm., diameter 1.7 mm., and was collected at San Pedro, California. Two specimens from the same locality were identified for Mrs. Oldroyd.

Named for Doctor P. P. Carpenter.

TURBONILLA (STRIOTURBONILLA) SIMPSONI, new species.

Plate 3, figs. 6, 6*a*.

Shell elongate-conic, rather slender, bluish-white. Nuclear whorls two and three-fourths, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are

The type (Cat. no. 162515, U.S.N.M.) and three additional specimens were dredged at U. S. Bureau of Fisheries station 2830, in 66 fathoms, temperature 74°.1, off Lower California. The type is not quite mature; it has nine post-nuclear whorls, and measures: Length, 4.5 mm.; diameter, 1.3 mm.

The following specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	U.S.B.F. station.	Locality.	Depth, fathoms.	Temperature, degrees.	Disposition of material.
162515......	4	2830	Off Lower California.......	66	74.1	U. S. Nat. Mus.
96561......	5	2830	.....do.....................	66	74.1	Do.
163253......	4	2823	Off La Paz, Lower California.	26½	....	Do.
191566......	1	2826	.....do.....................	9½	....	Do.

TURBONILLA (STRIOTURBONILLA) ATTRITA, new species.

Plate 4, figs. 11, 11*a*.

Shell slender, elongate-conic, bluish-white. Nuclear whorls small, two and one-half, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are slightly immersed. Post-nuclear whorls very high between the sutures, almost flattened, ornamented with very low, flattened, somewhat irregular, protractive axial ribs, which are best developed on the early whorls. Of these there are 18 upon the second, 22 upon the third, 18 upon the fourth and fifth, 22 upon the sixth, 18 upon the seventh, 20 upon the eighth and ninth; on the next turn they become quite enfeebled, and on the penultimate turn they are obsolete. Intercostal spaces about half as wide as the ribs and very shallow. Sutures well impressed. Periphery of the last whorl well rounded. Base short, somewhat inflated. Entire surface of the spire and base marked by numerous very fine, wavy spiral striations. Aperture broadly oval; posterior angle acute; outer lip thin; columella short, slender, somewhat curved, and slightly reflected.

The type and six individuals (Cat. no. 163248, U.S.N.M.) come from San Pedro, California. The type has twelve post-nuclear whorls and measures: Length 7.4 mm., diameter 1.6 mm. Cat. no. 163243, U.S.N.M., contains five specimens from San Pedro, California. Another specimen (Cat. no. 152314, U.S.N.M) comes from San Diego, California. Another specimen in Mr. Berry's collection is from Long Beach, California.

TURBONILLA (STRIOTURBONILLA) NICHOLSI, new species.

Plate 3, fig. 2.

Shell large and robust, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, slightly shouldered at the summit, marked by strong, somewhat sinuous, decidedly protractive axial ribs, of which 14 occur upon the first, 16 upon the second to sixth, 18 upon the seventh, 20 upon the eighth, 22 upon the ninth, and 25 upon the penultimate turn. Intercostal spaces almost as wide as the ribs, well impressed, terminating a little distance posterior to the suture. Sutures strongly marked. Periphery and rather long base of the last whorl well rounded, marked by the feeble continuations of the axial ribs. Entire surface of base and spire marked by numerous, strongly incised spiral striations, of which those on the spire somewhat exceed the ones on the base in strength. Aperture large, oval; outer lip thin, showing the external sculpture within; columella slender, sigmoid, slightly reflected.

The type (Cat. no. 160210, U.S.N.M.) was collected by Lieutenant Nichols in the Gulf of California. It has lost the nucleus. The twelve remaining whorls measure: Length 8.8 mm., diameter 2.4 mm.

TURBONILLA (STRIOTURBONILLA) TORQUATA Gould.

Plate 4, figs. 15, 15*a*.

Chemnitzia torquata GOULD, Bost. Journ. Nat. Hist., vol. 4, 1852, p. 384, pl. 14, fig. 16; not *Turbonilla* (*Strioturbonilla*) *torquata* (GOULD) DALL and BARTSCH, Mem. Cal. Acad. Sci., vol. 3, 1903, pp. 271, 272, pl. 2, figs. 4, 4a, which may take the name *Turbonilla* (*Strioturbonilla*) *ralphi* DALL and BARTSCH.

Shell robust, bluish-white. Nuclear whorls small, two, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fifth immersed. Postnuclear whorls well rounded, ornamented by strongly elevated, slightly protractive axial ribs, of which 16 occur upon all of the whorls except the penultimate, which has 22. Intercostal spaces about twice as wide as the ribs, terminating a little above the summit of the preceding whorl, thus leaving a narrow, plain band in the suture. Sutures strongly impressed. Periphery of the last whorl well rounded. Base moderately long, well rounded. Entire surface of spire and base crossed by numerous very fine, closely spaced, wavy, spiral striations. Aperture suboval, outer lip thin, showing the external sculpture within. Columella slender, decidedly curved, and somewhat reflected.

The specimen described and figured (Cat. no. 205934, U.S.N.M.) has lost the nucleus. The eleven remaining whorls measure: Length 6.5 mm., diameter 2.1 mm., and comes from off Point Firmin, California. Another specimen (Cat. no. 60916, U.S.N.M.) comes from San Diego, California. Still another (Cat. no. 205935, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 4322, in 110 to 197 fathoms, off La Jolla, California. Two additional specimens in the University of California collection were obtained at their stations 22 and 28 off San Diego. Mr. Berry's collection contains two specimens dredged in 40 fathoms off Catalina Island, California.

TURBONILLA (STRIOTURBONILLA) STYLINA Carpenter.

Plate 3, figs. 7, 7*a*.

Chemnitzia (*?torquata* var.) *stylina* CARPENTER, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 396. *Turbonilla* (*Strioturbonilla*) *torquata stylina* DALL and BARTSCH, Mem. Cal. Acad. Sci., vol. 3, 1903, p. 272, in part. *Turbonilla* (*Strioturbonilla*) *stylina* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 497, pl. 44, figs. 11, 11a.

Shell slender, subdiaphanous to milk-white. Nuclear whorls two, smooth, depressed, helicoid, scarcely extending beyond the outline of the spire and having their axis at right angles to the axis of the succeeding turns. Post-nuclear whorls well rounded, separated by strongly constricted sutures, rather high, ornamented by rather low, broad, rounded, sinuous, protractive axial ribs, of which there are 16 upon the first, 20 upon the fifth, and 28 upon the penultimate turn. Intercostal spaces moderately depressed, about as wide as the ribs, terminating a short distance above the sutures, thus leaving a narrow, smooth band between the termination of the ribs and the suture as in *T.* (*Strioturbonilla*) *torquata* Gould, but not quite as wide as in that species. Periphery of the last whorl well rounded. Base rather short, well rounded. Entire surface marked by very fine, wavy spiral striations. Aperture subovate, outer lip thin; columella slender, moderately long, slightly twisted, almost vertical. The specimen described and figured (Cat. no. 56429, U.S.N.M.) was collected by Doctor Dall in 8 or 10 fathoms at Monterey, California. It has 11 post-nuclear whorls and measures: Length 6.5 mm., diameter 1.7 mm. (not 8 and 1.9 mm., as erroneously stated in the last-cited reference). Another specimen was dredged in 12 fathoms off Del Monte, Monterey, by Mr. S. S. Berry (Cat. no. 165199, U.S.N.M.). Two specimens (Cat. no. 163249, U.S.N.M.), both immature, dredged by the Bureau of Fisheries steamer *Albatross* at station 2932 in 50 fathoms off Coronado Island, are provisionally referred to this form.

TURBONILLA (STRIOTURBONILLA) CALVINI, new species.

Plate 4, figs. 1, 1*a*.

Shell elongate-conic, milk-white. Nuclear whorls two and three-fourths, forming a decidedly elevated helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Early post-nuclear whorls strongly rounded, decidedly shouldered at the summit, and constricted at the sutures. Later ones flattened in the middle, less shouldered and less contracted. Axial ribs strong, sublamellar, shouldered a little below the summit; 14 upon the first to ninth, 16 upon the tenth, and 18 upon the penultimate turn. Intercostal spaces about two and one-half times as wide as the ribs, well impressed, a little more so on the shoulder than on the summit, which gives them a contracted appearance at this place, terminating a little above the suture. Sutures well impressed. Entire surface of base and spire marked by fine, wavy, spiral striations. Periphery and the moderately long base of the last whorl well rounded. Aperture rhomboidal; outer lip thin, showing the external sculpture within; columella moderately strong, slightly curved.

The two cotypes and four additional specimens (Cat. no. 162442, U.S.N.M.) were dredged by the U. S. Bureau of Fisheries, at station 2823, in 26½ fathoms off La Paz, Lower California. One of the cotypes has the nucleus and nine post-nuclear whorls, and measures: Length 3.1 mm., diameter 0.9 mm. The other cotype consists of the last seven post-nuclear whorls; if perfect, it would probably have had twelve. This measures: Length 3.6 mm., diameter 1.2 mm.

Named for Prof. Samuel Calvin.

TURBONILLA (STRIOTURBONILLA) CARPENTERI, new species.

Plate 3, figs. 9, 9*a*.

Shell long, slender, bluish-white. Nuclear whorls small, two and one-half depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fifth immersed. Post-nuclear whorls exceedingly high between the sutures, evenly rounded, marked by almost vertical axial ribs, which become slightly expanded and flattened at the summits. There are 18 of these ribs upon the first to third, 20 upon the fourth to sixth, 22 upon the seventh, 24 upon the eighth and ninth, and 26 upon the tenth. Upon the penultimate turn they become decidedly irregular and enfeebled. Intercostal spaces about one-half as wide as the ribs, but little depressed below the general surface of the shell. Sutures somewhat constricted. Periphery of the last whorl well rounded. Base short and somewhat inflated, marked by feeble extensions of the axial ribs. Entire surface of spire and base crossed by numerous fine, wavy, spiral striations. Aperture subquadrate, rather elongated, posterior angle obtuse, outer lip thin; columella rather long, slender, slightly sinuous.

The type (Cat. no. 160065, U.S.N.M.) has twelve post-nuclear whorls, and measures: Length 7.9 mm., diameter 1.7 mm., and was collected at San Pedro, California. Two specimens from the same locality were identified for Mrs. Oldroyd.

Named for Doctor P. P. Carpenter.

TURBONILLA (STRIOTURBONILLA) SIMPSONI, new species.

Plate 3, figs. 6, 6*a*.

Shell elongate-conic, rather slender, bluish-white. Nuclear whorls two and three-fourths, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Post-nuclear whorls well rounded, marked by very strong, well raised, almost vertical axial ribs, of which 16 occur upon all the whorls of the type. These ribs are strongest in the middle and slightly lower at the summit and periphery. Intercostal spaces deeply impressed, equaling the ribs in width, terminating a very little posterior to the suture. Sutures somewhat constricted. Periphery of the last whorl well rounded. Base rather short, well rounded. Entire surface of spire and base marked by fine, wavy, spiral striations. Aperture subquadrate, posterior angle obtuse; outer lip thin, showing the external sculpture within; columella short, slender, and oblique.

The type (Cat. no. 152750, U.S.N.M.) has lost the nucleus and probably the first one and one-half post-nuclear turns; the 12 remaining measure: Length 6.7 mm., diameter 1.6 mm. It and another specimen, listed under the same number, were collected in 10 fathoms off San Pedro, California.

The following specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	Univ. Cal. station.	Locality.	Depth, fathoms.	Disposition of material.
152750	2	....	Off San Pedro, California..........	10	U. S. Nat. Mus.
163247	4	....	.....do..........	....	Do.
122750	1	....	.....do..........	....	Do.
	6	....	.....do..........	....	Oldroyd coll.
152314*b*	1	....	San Diego, California..........	....	U. S. Nat. Mus.
205941	2	....	.....do..........	....	Do.
	4	12	Off Redondo, California..........	....	Univ. Cal. coll.
	1	27	Off Catalina Island, California.......	....	Do.
	5	32	.....do..........	....	Do.
	1	47	Off Long Beach, California..........	....	Do.

Named for Charles T. Simpson.

TURBONILLA (STRIOTURBONILLA) PROFUNDICOLA, new species.

Plate 3, figs. 11, 11*a*.

Shell elongate-conic, milk-white, shining. Nuclear whorls very small, two and one-half, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are but very slightly immersed. Post-nuclear turns well rounded, very slightly shouldered at the summit, marked by gently protractively curved, low, rounded, well-developed axial ribs, of which 16 occur upon the first three whorls, 18 upon the fourth and fifth, 20 upon the sixth and seventh, 22 upon the eighth and the penultimate turn. Intercostal spaces about one and one-half times as wide as the ribs, well impressed, terminating about one-tenth of the width of the space between the sutures, posterior to the basal suture, leaving the part anterior between their termination and the basal suture as a plain band. Sutures strongly constricted. Periphery of the last whorl well rounded. Base short, well rounded. Entire surface of spire and base marked by numerous microscopic, closely crowded, wavy, spiral striations. Aperture subquadrate, very broad at base, posterior angle obtuse; outer lip thin, bent very strongly at its basal angle; columella slender, slightly oblique, almost straight, weakly revolute.

The type (Cat. no. 206856, U.S.N.M.) has ten post-nuclear whorls, and measures: Length 6.3 mm., diameter 1.9 mm. It was dredged by the U. S. Bureau of Fisheries at station 4322, off La Jolla, California, in 110 to 197 fathoms. Another specimen was dredged by the University of California off Catalina Island.

TURBONILLA (STRIOTURBONILLA) GALIANOI, new species.

Plate 4, figs. 12, 12*a*.

Shell elongate-conic, milk-white, shining. Nuclear whorls very small, two and one-half, forming a rather elevated spire, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Post-nuclear whorls well rounded, very strongly tabulately shouldered at the summit, ornamented with well-developed, rounded, slightly protractively curved axial ribs. Of these ribs, 16 occur upon the first, second, and third, 18 upon the fourth and fifth, 20 upon the sixth, 22 upon the seventh, 24 upon the eighth, 26 upon the ninth, and 28 upon the penultimate turn. These ribs extend equally strong from the summit to the periphery of the whorls. Intercostal spaces not quite as wide as the ribs, well impressed, extending anteriorly to the suture. Sutures strongly constricted. Periphery of the last whorl well rounded. Base rather long, well rounded. Entire surface of spire and base marked by exceedingly fine spiral striations. Aperture subquadrate, posterior angle obtuse; outer lip thin, showing the external sculpture within; columella almost straight, slightly revolute.

The specimen described and another individual (Cat. no. 4104, U.S.N.M.) were collected by J. Xantus at Cape St. Lucas, Lower California. It lacks the nucleus; the ten remaining whorls measure: Length 6.1 mm., diameter 1.8 mm.

Three additional specimens (Cat. no. 162437, U.S.N.M.) come from Pacific Beach, San Diego, California. Cat. no. 162438, U.S.N.M., three specimens from San Hipolite Point, Lower California. Cat. no. 162441, U.S.N.M., another specimen from the same locality. Cat. no. 162439, U.S.N.M., two specimens from Point Abreojos, Lower California. The Delos Arnold collection contains two individuals from San Hipolite Point, Lower California.

Named for Galiano, the Spanish explorer of California.

TURBONILLA (STRIOTURBONILLA) HUMEROSA, new species.

Plate 3, figs. 10, 10*a*.

Shell elongate-conic, milk-white. Nuclear whorls very small, two and one-half, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Post-nuclear whorls very strongly rounded, moderately shouldered at the summit, marked by many strong lamellar, protractive axial ribs, which slope suddenly from a point about one-third of the distance between the sutures, anterior to the summit, giving the whorls a shouldered appearance at this place. Of these ribs, 14 occur upon the second to fourth, 16 upon the fifth to ninth, 18 upon the tenth, and 20 upon the penultimate turn. Intercostal spaces deeply impressed, double the width of the ribs. Sutures strongly marked. Periphery of the last whorl well rounded. Base short, well rounded. Entire surface of spire and base marked by many fine, wavy, spiral striations. Aperture subquadrate, posterior angle obtuse. Outer lip rather thick and somewhat revolute.

The type (Cat. no. 206857, U.S.N.M.) was collected off Catalina Island, California. It has twelve post-nuclear whorls and measures: Length 6 mm., diameter 1.7 mm. Two additional specimens (Cat. no. 205937) were collected at San Diego, California.

TURBONILLA (STRIOTURBONILLA) C-B-ADAMSI Carpenter.

Plate 3, fig. 3.

Chemnitzia C-B-Adamsi CARPENTER, Cat. Maz. Shells, 1856, p. 427.

Shell elongate-conic, milk-white. Nuclear whorls two and one-half, forming a moderately elevated helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls slightly rounded, slightly contracted at the suture, somewhat shouldered at the summit, marked by well-developed, rounded, somewhat protractive axial ribs, of which 12 occur upon the first and second, 14 upon the third to sixth, 16 upon the seventh, and 18 upon the penultimate whorl. Intercostal spaces a little wider than the ribs, terminating at the periphery, marked by very distinct, equally spaced, equal spiral striations. Sutures well marked, rendered wavy by the ribs. Periphery and base of the last whorl well rounded. Aperture rhomboidal; outer lip thin; columella moderately curved.

The type and twelve specimens were collected off *Chama* and *Spondylus* at Mazatlan, Mexico. The type is on tablet 1990, Liverpool collection, British Museum. It has nine post-nuclear whorls, and measures: Length 3.75 mm., diameter 0.9 mm.

TURBONILLA (STRIOTURBONILLA) SERRÆ Dall and Bartsch.

Plate 4, figs. 3, 3*a*.

Turbonilla (*Strioturbonilla*) *serræ* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pl. 44, figs. 8, 8a.

Shell slender, very elongate-conic, subdiaphanous to milk-white. Nuclear whorls two and one-half, depressed, helicoid, having their axis at right angles to that of its succeeding turns, in the first of which they are about one-fifth immersed. Post-nuclear whorls very high between the sutures, moderately rounded, slightly contracted at the periphery and somewhat shouldered at the summit, rendering the sutures subchannelled. The whorls are marked by subequal and subequally spaced, rather broad, rounded, almost vertical axial ribs, which are a little wider than the intercostal spaces, the depressed portion of the latter terminating a little above the suture. In the type, which has lost the nucleus and probably the first two post-nuclear turns, there are 16 ribs on the third of the remaining whorls, 20 on the eighth, 22 upon the eleventh, and 34 upon the next, the penultimate turn. On this whorl the axial ribs are less regular and less strongly developed, showing senile degeneration. Periphery of the last whorl well rounded. Base short, well rounded, marked by slender continuations of the axial ribs, which extend feebly to the insertion of the columella. Entire surface of spire and base crossed by numerous closely placed spiral striations. Aperture subquadrate, posterior angle obtuse, outer lip thin, columella rather strong, somewhat oblique, and slightly revolute, without apparent fold in the aperture. The type has thirteen whorls and measures: Length 7.7 mm., diameter 1.4 mm.

The type and seven specimens were collected by Mr. S. S. Berry in 12 fathoms off Del Monte, Monterey, California; five of these are in Mr. Berry's collection. The type and one other, form Cat. no. 196198. Cat. no. 196200, U.S.N.M., contains a specimen from 40 fathoms off Pacific Grove, Monterey, California, dredged by Mr. Berry. Another specimen in Mr. Berry's collection was dredged in shelly sand at Monterey, California, at a depth of 29 fathoms.

This species is nearest related to *Strioturbonilla stylina* Carpenter, but can readily be distinguished from it by its less rounded whorls, straighter and much stronger ribs, and by having the ribs continuing over the base, and scarcely any space showing between the termination of the intercostal spaces and the suture.

It is named in honor of Father Junipero Serra, the early Spanish missionary to California.

TURBONILLA (STRIOTURBONILLA) ARESTA, new species.

Plate 4, figs. 5, 5*a*.

Shell very slender, milk-white. Nuclear whorls small, two and one-half, forming a moderately elevated, helicoid spire, which has its axis at right angles to that of the succeeding whorls, and is not at all immersed. Post-nuclear whorls moderately rounded, marked by sublamellar, protractive axial ribs, which extend undiminished to the summit of the whorls, rendering this crenulated. There are 14 of these upon the first three whorls, 16 upon the fourth to eighth, 18 upon the ninth, 20 upon the tenth and eleventh, and 21 upon the penultimate turn. Intercostal spaces about one and one-half times as wide on all but the last three whorls; on the latter they are about as wide as the ribs and terminate a little posterior to the suture. Sutures strongly marked. Periphery of the last whorl faintly angulated. Base short, well rounded. Aperture moderately large, subquadrate, posterior angle obtuse. Outer lip thin, bent almost at right angles to the anterior lateral angle. Columella slender, slightly curved and slightly revolute.

The type (Cat. no. 206858, U.S.N.M.) has thirteen post-nuclear whorls and measures: Length 6.4 mm., diameter 1.2 mm. It was dredged off Catalina Island, together with nine additional specimens, by the University of California. Five additional specimens were dredged by the same institution off San Diego. Another specimen (Cat. no. 163252, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2901, off Santa Rosa Island, in 48 fathoms. Another specimen (Cat. no. 206863, U.S.N.M.) comes from San Diego.

TURBONILLA (STRIOTURBONILLA) PAZANA, new species.

Plate 4, figs. 13, 13*a*.

Shell very slender, elongate-conic, milk-white. Nuclear whorls two and three-fourths, forming a decidedly elevated spire, the axis of which is at a right angle to that of the succeeding turns, in the first of which it is scarcely at all immersed. Post-nuclear whorls moderately rounded, with very feebly shouldered summits, ornamented with well-developed narrow protractive axial ribs, 14 occur upon the first to tenth, and 16 upon the remaining turns. Intercostal spaces about two and one-half times as wide as the ribs, well impressed, marked by exceedingly fine, closely spaced, spiral striations. Sutures well impressed, rendered somewhat sinuous by the ribs. Periphery of the last whorl somewhat angulated. Base short, well rounded, marked by fine spiral striations. Aperture rather long, rhomboidal; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella moderately strong, curved, and slightly revolute.

The type (Cat. no. 162430, U.S.N.M.) and 35 specimens were dredged at U. S. Bureau of Fisheries station 2823, in 26½ fathoms, off La Paz, Lower California. The type has fourteen post-nuclear whorls and measures: Length 5.7 mm., diameter 0.8 mm. Cat. no. 163250, U.S.N.M., two from U. S. Bureau of Fisheries station 2822, 21 fathoms, off La Paz, Lower California; Cat. no. 162431, U.S.N.M., seven from U. S. Bureau of Fisheries stations 2826 and 2828, 9½ to 10 fathoms, off Cerros Island. Cat. no. 191565, U.S.N.M., three specimens from U. S. Bureau of Fisheries stations 2826 and 2828, off Ceralvo Island, Gulf of California, same depth and locality as the preceding.

TURBONILLA (STRIOTURBONILLA) GALAPAGENSIS, new species.

Plate 4, fig. 7.

Shell yellowish-white. (Early whorls decollated.) Post-nuclear whorls contracted a little posterior to the middle between the sutures, which gives them a concave outline, slightly shouldered at the summit and somewhat contracted at the sutures; marked by about 22 low, rounded, almost vertical, axial ribs. Intercostal spaces almost as wide as the ribs, marked by fine lines of growth, which gives them a somewhat crinkly appearance, and two incised spiral lines at the contracted part. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs. Aperture somewhat fractured, pear-shaped?

The type (Cat. no. 206859, U.S.N.M.) was obtained at U. S. Bureau of Fisheries station 2808, in 634 fathoms, temperature 39.9°, off the Galapagos Islands. It consists of the last four and one-half whorls and measures: Length 3.5 mm., diameter 1.6 mm.

TURBONILLA (STRIOTURBONILLA) UNDATA Carpenter.

Plate 4, fig. 8.

Chemnitzia undata CARPENTER, Cat. Mazatlan Shells, 1856, pp. 431, 432.

"Shell graceful, slender, soiled white. Nuclear whorls extending somewhat beyond the outline of the post-nuclear spire. Post-nuclear whorls subplanate, separated by strong sutures and marked by about eighteen narrow, acute axial ribs which are very weak at the periphery and disappear entirely on the base. Intercostal spaces broad, marked by superficial spiral striations which are strongest at the periphery. Outer lip thin; columella graceful, scarcely twisted."

The above is Carpenter's description, to which he adds: "On comparing this shell with the corresponding portion of *C. gracilior* C. B. Ads., it is found to have fewer and much finer and sharper ribs which do not end at the periphery, like the curved interspaces; length 1.6 mm., diameter 0.55 mm. Hab. Mazatlan; two young perfect specimens off *Spondylus;* Liverpool collection, tablet 2002 contains the larger specimen; the smallest is of a much darker color."

The specimen referred to above, tablet 2002, is a badly worn young shell, with indications of very protractive axial ribs and finely spirally striated base.

Carpenter's manuscript figure is evidently taken from the young individual referred to above, which shows a peripheral series of pits and numerous fine spiral striations.

TURBONILLA (STRIOTURBONILLA) AFFINIS C. B. Adams.

Plate 4, fig. 14.

Chemnitzia affinis C. B. ADAMS, Ann. Lyc. Nat. Hist., of N. Y., vol. 5, 1852, p. 389.

Shell slender, wax yellow, with a narrow brighter colored band about one-third of the distance between the sutures, anterior to the summit. (Nuclear whorls decollated.) Post-nuclear whorls slightly rounded and moderately shouldered at the summit, marked by well-rounded, low, slightly protractive axial ribs, of which 18 occur upon the first and second, 20 upon the third and fourth, 22 upon the fifth, 24 upon the sixth and the remaining turns. Intercostal spaces a little narrower than the ribs, shallow, marked by a moderately strong series of peripheral pits and probably 60 to 80 fine, equal, and equally spaced, strongly incised spiral lines. Periphery and base well rounded, marked by numerous, closely spaced, well incised, wavy spiral striations. Aperture rhomboid, outer lip thin, showing the external sculpture within; columella moderately strong, almost straight and somewhat revolute.

Professor Adams's type, which has served for our description and figure, consists of the last eight whorls and measures: Length 5.3 mm., diameter 1.3 mm. It is in the Amherst College collection and comes from Panama.

TURBONILLA (STRIOTURBONILLA) PHANEA, new species.

Plate 4, figs. 4, 4*a*.

Shell very small and slender, milk-white. Nuclear whorls two, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Post-nuclear whorls well rounded, with their greatest convexity on the anterior third between the sutures. Summits appressed, marked by strong, narrow, slightly protractive axial ribs, of which fourteen occur upon all of the whorls. Intercostal spaces about three times as wide as the ribs, marked between the sutures by a peripheral series of pits and sixteen equal and equally spaced incised fine lines. Sutures well impressed. Periphery of the last whorl well rounded, appearing as a plain band. Base short, well rounded, marked by the faint continuations of the axial ribs and about fifteen very fine, wavy incised, spiral lines, of which the first below the periphery is a little stronger than the rest. Aperture rhomboid, rather long; posterior angle acute; outer lip thin, showing the external sculpture within; columella rather long, almost straight, slightly revolute; parietal wall marked by a faint callus.

The type and two additional specimens (Cat. no. 206860, U.S.N.M.) were obtained at U. S. Bureau of Fisheries station 2823, in 26½ fathoms, on broken-shell bottom, off La Paz, in the Gulf of California. The type has 8 post-nuclear whorls and measures: Length 3.2 mm., diameter 0.8 mm. Cat. no. 163251, U.S.N.M., contains a specimen dredged at U. S. Bureau of Fisheries station 2822, in 21 fathoms, off La Paz, Lower California. Cat. no. 206861, U.S.N.M., has five specimens dredged at U. S. Bureau of Fisheries stations 2826 to 2828, in 9½ to 10 fathoms, off Ceralvo Island, Lower California.

TURBONILLA (STRIOTURBONILLA) IMPERIALIS, new species.

Plate 4, figs. 2, *2a*.

Shell elongate-conic, milk-white, with a narrow, faint yellow band in the middle of the whorls between the sutures. Nuclear whorls at least two, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-half immersed. Post-nuclear whorls well rounded, depressed at the summit, somewhat contracted at the sutures, marked by slender, almost vertical axial ribs, of which 20 occur upon the first and second, 22 upon the third, 24 upon the fourth, 26 upon the sixth and penultimate turn. Intercostal spaces are twice as wide as the ribs, marked by a series of moderately strong pits at the periphery, and about twenty-six well incised, equal and subequally spaced spiral striations, which pass up on the side of the ribs but do not cross their summits. Periphery of the last whorl angulated. Base short, well rounded, marked by the very feeble continuations of the axial ribs and about twelve equally strong, slender, wavy, spiral striations. Aperture defective, rhomboidal?

The type (Cat. no. 206862, U.S.N.M.) comes from Panama. It has 8 post-nuclear whorls and measures: Length 3.3 mm., diameter 1.1 mm.

TURBONILLA (STRIOTURBONILLA) SMITHSONI, new species.

Plate 4, figs. 10, *10a*.

Shell very regularly conic, wax yellow, the area from a little above the suture to the middle of the whorls between the sutures a little higher than the rest. Nuclear whorls small, at least two-thirds obliquely immersed in the first post-nuclear turn, beyond the outline of which it extends some on the left side. Post-nuclear whorls decidedly flattened, very slightly shouldered at the summit, scarcely at all contracted at the periphery, marked by rounded, low, poorly developed, axial ribs, of which 18 occur upon the first and second, 22 upon the third, 24 upon the fourth, 28 upon the fifth, 32 upon the sixth and the penultimate turn. Intercostal spaces a little narrower than the ribs, shallow, marked by series of well-impressed pits at the periphery and a second one a little less strong a little anterior to the middle of the space between the sutures; the space between the peripheral and the other series of pits is crossed by about twenty-five equal and equally spaced spiral striations; that between the middle pits and the suture by about forty of equal strength. Sutures poorly defined. Periphery and base of the last whorl well rounded, marked by numerous fine, wavy, spiral striations. Aperture? (outer lip fractured); columella strong, with an oblique fold a little below the insertion.

The type (Cat. no. 160068, U.S.N.M.) comes from Cape St. Lucas. It has 8 post-nuclear whorls and measures: Length 4 mm., diameter 1.3 mm. Cat. no. 46502, U.S.N.M., contains a specimen from Boca de los Piedras.

Named for James Smithson.

TURBONILLA (STRIOTURBONILLA) GRACILIOR C. B. Adams.

Plate 4, fig. 6.

Chemnitzia gracilior C. B. Adams, Ann. Lyc. of Nat. Hist. N. Y., vol. 5, 1852, p. 391.

Shell elongate-conic, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, moderately shouldered at the summit; later ones slightly exserted at the summit; marked by slender, sinuous, slightly protractive axial ribs, of which 16 occur upon the first and second, 18 upon the third, 20 upon the fourth to seventh, 22 upon the eighth, 26 upon the ninth, and 32 upon the penultimate turn. Intercostal spaces about twice as wide as the ribs, marked by a double series of pits, the first of which is at the periphery, the second a little posterior to the middle between the sutures. In addition to these pits, they are marked by fine, equal and equally spaced spiral striations of which thirty-one probably occur between the peripheral and median pit and twenty between that and the summit. Sutures well marked. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs and numerous fine, well-incised, wavy spiral striations. Aperture rather long, rhomboidal; outer lip fractured; columella moderately strong, slightly curved and somewhat reflected, provided with a weak oblique fold at its insertion.

Professor Adams's type has served for our description and figure. It has lost the nucleus. The eleven remaining whorls measure: Length 6.1 mm., diameter 1.4 mm. It is in the Amherst College collection and comes from Panama.

Subgenus PTYCHEULIMELLA Sacco.

Ptycheulimella SACCO, I. Moll. de Piemonte e della Liguria, pt. 11, 1892, p. 59.

Shell elongate-conic. Axial sculpture consisting of obsolete ribs frequently only shown in the early post-nuclear turns. Spiral sculpture, if present, consisting of microscopic striations only.

Type.—*Tornatella pyramidata* Deshayes.

KEY TO THE SPECIES OF THE SUBGENUS PTYCHEULIMELLA.

Shell very broadly conic	*obsoleta.*
Shell slender	*abreojensis.*

TURBONILLA (PTYCHEULIMELLA) OBSOLETA Carpenter.

Plate 5, fig. 6.

? *Eulimella obsoleta* CARPENTER, Cat. Mazatlan Shells, 1856, p. 436.

Shell broadly elongate, grayish white. Post-nuclear whorls feebly rounded, marked by obsolete axial ribs which are best shown immediately below the appressed summit. Entire surface marked by extremely fine spiral lines. Aperture rhomboidal; posterior angle acute; outer lip thin; columella slightly twisted and somewhat revolute.

The type which is on tablet 2011, Liverpool collection, British Museum, has lost its early whorls, the four and one-half remaining measure: Length 1.5 mm., diameter 0.6 mm. It comes from Mazatlan, Mexico.

TURBONILLA (PTYCHEULIMELLA) ABREOJENSIS, new species.

Plate 5, fig. 7.

Shell conic, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls moderately well rounded, very slightly shouldered at the summit, marked by mere indications of obsolete ribs near the summit of the early whorls, only. Sutures well impressed. Periphery well rounded. Base moderately long, well rounded. Surface of spire and base marked by fine, closely crowded, spiral striations. Aperture oval; posterior angle acute; columella rather strong, moderately curved, somewhat revolute, provided with an oblique fold a little anterior to the insertion.

The unique type (Cat. no. 205951, U.S.N.M.) comes from Point Abreojos, Lower California. It has lost the nucleus and first post-nuclear whorl. The nine remaining measure: Length 5.2 mm., diameter 1.6 mm.

Subgenus PYRGOLAMPROS Sacco.

Pyrgolampros SACCO, I. Moll. del Piemonte e della Liguria, 1892, p. 85.

Turbonillas with low, broad, rounded vertical ribs which almost always disappear as they pass over the periphery and base of the last whorl, and many very fine, faint, wavy spiral striations; surface covered by a thin epidermis. Columella usually somewhat flexuose.

Type.—*Pyrgolampros mioperplicatulus* Sacco.

All our west American species are of a light-yellow to chocolate-brown color. The intercostal spaces are not depressed as in *Chemnitzia*, but appear as simple shallow undulations between the axial ribs. The spiral striations, in perfect specimens, appear as if they were situated beneath a light-colored epidermis and were shining through it.

KEY TO THE SPECIES OF THE SUBGENUS PYRGOLAMPROS.

- Axial ribs well developed.
  - Shell short and stout.
    - Shell unicolor.
      - Whorls excurved at the summit........................*victoriana*, p. 61.
      - Whorls not excurved at the summit.
        - Shell brown.
          - Axial ribs 12–16................................*gibbosa*, p. 61.
          - Axial ribs 18–20................................*ridgwayi*, p. 62.
        - Shell light fulvous................................*valdezi*, p. 62.
    - Shell banded..*newcombei*, p. 63.
  - Shell elongate-conic.
    - Shell unicolor.
      - Shell large, adult more than 10 mm. long................*taylori*, p. 64.
      - Shell smaller, adult less than 8 mm. long.
        - Whorls well rounded................................*lowei*, p. 64.
        - Whorls flattened.
          - Axial ribs strong, acute........................*halibrecta*, p. 65.
          - Axial ribs weak, rounded........................*gouldi*, p. 66.
    - Shell bicolor.
      - Spire golden yellow, base white........................*aurantia*, p. 66.
      - Posterior two-thirds between the sutures light brown, anterior third and base darker........................*pedroana*, p. 67.
    - Shell banded.
      - Band single, broad, extending over the periphery and to both sides of it.
        - Shell large, adult more than 8 mm. long..............*halia*, p. 68.
        - Shell small, adult less than 6 mm. long..............*lyalli*, p. 68.
      - Bands double.
        - Bands lighter than rest of shell......................*berryi*, p. 69.
        - Bands darker than rest of shell......................*alaskana*, p. 70.
      - Bands triple.
        - Bands not visible on the spire only in the outer lip..*chocolata*, p. 70.
      - Bands visible on the spire.
        - Axial ribs on penultimate whorl 22....................*painei*, p. 71.
        - Axial ribs on penultimate whorl 30....................*keepi*, p. 71.
- Axial ribs poorly developed on the early whorls, never indicated on the later ones.
  - Shell dark brown with a narrow lighter band..................*halistrepta*, p. 72.
  - Shell wax yellow with a light brown peripheral zone.
    - Shell large, adult more than 11 mm. long....................*lituyana*, p. 73.
    - Shell smaller, adult less than 9 mm. long..................*oregonensis*, p. 73.

TURBONILLA (PYRGOLAMPROS) VICTORIANA Dall and Bartsch.

Plate 5, fig. 3.

Turbonilla (*Pyrgolampros*) *victoriana* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 501, pl. 44, fig. 6.

Shell elongate-conic, wax yellow to light brown. Nuclear whorls and the early succeeding turns eroded in all the specimens examined. Post-nuclear whorls quite high between the sutures, somewhat concave in the posterior two-thirds of the exposed portion, only slightly contracted toward the periphery and faintly shouldered at the summit; ornamented by low, rounded, somewhat sinuous axial ribs, which are about as wide as the shallow intercostal spaces. Sutures well marked. Periphery and base of the last whorl somewhat inflated, marked by weak continuations of the axial ribs which extend feebly to the umbilical region. Entire surface crossed by numerous, wavy spiral striations. Aperture rather elongate, oval, outer lip thin; columella moderately long, decidedly twisted and somewhat revolute in its free anterior portion; the twist at its insertion appearing as a fold.

The type (Cat. no. 126660*a*, U.S.N.M.) was collected by Dr. C. F. Newcombe at Victoria, Vancouver Island, British Columbia. It has the last seven and a half whorls and measures: Length 7 mm., diameter 2.1 mm. Ten additional speciments were collected by Rev. G. W. Taylor, at Departure Bay, Vancouver Island, British Columbia, four of which form Cat. no. 196220, U.S.N.M.

This species appears nearest related to *Turbonilla* (*Pyrgolampros*) *newcombei* Dall and Bartsch, but is readily distinguished from that form by its concave whorls.

TURBONILLA (PYRGOLAMPROS) GIBBOSA Carpenter.

Plate 6, fig. 2.

Chemnitzia gibbosa CARPENTER, Cat. Mazatlan Shells, 1856, p. 430.

Shell pupiform, reddish brown, irregular. (Nuclear whorls decollated.) Post-nuclear whorls ten, flattened, marked with about eighteen poorly developed, more or less rounded, vertical axial ribs. This species is described, although from a solitary and very imperfect specimen, in consequence of its great peculiarity of form, in which it resembles *Chrysallida*. It is short, stumpy, and very broad; without any trace of fold on the columella or notch on the base. Length 6.75 mm., diameter 5 mm.

Habitat.—Mazatlan; off *Chama*, extremely rare; Liverpool collection.

Tablet 1996 contains all that was found, namely, the broken specimen, and a fresh fragment displaying sculpture.

The above is Doctor Carpenter's original description. An examination of the two speciments in the British Museum sheds little additional light. The fragment is a thick, stumpy shell too poor to be determined. The small individual is of a light-brown color, showing irregular axial ribs and smooth intercostal spaces.

TURBONILLA (PYRGOLAMPROS) RIDGWAYI, new species.

Plate 6, figs. 10, 10*a*.

Shell robust, brown. Nuclear whorls two and one-half, moderately large, forming a depressed helicoid spire, the axis of which is almost at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Post-nuclear whorls flattened in the middle, rounded at the moderately strong shoulder at the summit, and at the periphery; marked by strong, well elevated, rounded, almost vertical axial ribs, which are slightly contracted in the middle and somewhat sinuous. Of these ribs, 18 occur upon the third to sixth and 20 upon the penultimate whorl. Intercostal spaces well impressed, decidedly so in the middle, a little wider than the ribs. Sutures strongly marked, rendered sinuous by the ribs at the summits of the whorls. Periphery of the last whorl well rounded. Base moderately long, well rounded, marked by the feeble continuations of the axial ribs. Entire surface of base and spire marked by closely crowded, wavy, well-incised spiral striations. Aperture moderately large, oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella moderately strong, somewhat curved and revolute, provided with a weak oblique fold at its insertion.

The type (Cat. no. 162560, U.S.N.M.) comes from San Diego, California. It has seven post-nuclear whorls and measures: Length 4.6 mm., diameter 2 mm.

Named for Robert Ridgway of the U. S. National Museum.

TURBONILLA (PYRGOLAMPROS) VALDEZI Dall and Bartsch.

Plate 6, fig.8.

Turbonilla (*Pyrgolampros*) *gibbosa* DALL and BARTSCH, Mem. Cal. Acad. Sci., vol. 3, 1903, pp. 27–9, pl. 1, figs. 2, 2*a*, not *Chemnitzia gibbosa* CARPENTER, Cat. Maz. Shells, 1856, p. 430, No. 525.—*Turbonilla* (*Pyrgolampros*) *valdezi* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 502, pl. 44, figs. 3, 3*a*.

Shell inflated, robust, broad and stumpy, of light fulvous coloration. Nuclear whorls decollated in the type. Post-nuclear whorls flattened, somewhat contracted at the periphery and rounded at the summit, traversed by broad, coarse, irregularly slanting axial ribs, which extend over the inflated periphery of the last whorl to the umbilical region, appearing less prominent on the base. About 16 of these ribs occur upon the second, 18 upon the fifth, and 24 upon the penultimate post-nuclear whorl. Entire surface of the shell crossed by very minute, close spiral striation. Suture subchanneled and wavy. Aperture ovate, outer lip thin, joining the twisted and revolute columella in a broad curve.

The type (Cat. no. 32273, U.S.N.M.) was collected at Monterey, California. It has seven post-nuclear whorls and measures: Length 5.6 mm., diameter 2.1 mm.

Another specimen, not quite adult (Cat. no. 176624, U.S.N.M.), comes from Pacific Grove, California. This has the nuclear whorls preserved, which are two, depressed helicoid, smooth, obliquely about one-fourth immersed in the first of the succeeding turns, having their axis at right angles to that of the later whorls. The left side of its nucleus projects slightly beyond the outline of the spire.

The present form is in every way much more robust than *T.* (*P.*) *gibbosa* Carpenter, which was described from Mazatlan, Mexico.

TURBONILLA (PYRGOLAMPROS) NEWCOMBEI Dall and Bartsch.

Plate 6, fig. 3.

Turbonilla (*Pyrgolampros*) *newcombei* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 503, pl. 45, fig. 6.

Shell regularly, broadly conic, white on the posterior half and light brown on the anterior half of the exposed portion of the whorl; base white. Nuclear whorls decollated in all the specimens seen. Post-nuclear whorls somewhat overhanging, decidedly contracted toward the periphery from the anterior fifth of the exposed part; almost flattened posterior to this, and closely appressed at the summit, separated by strongly marked sutures. Ribs about 18 upon all the turns, almost vertical, moderately elevated, rounded in the middle, decidedly flattened and widened at the summit, disappearing at the periphery. Intercostal spaces not depressed below the general surface, a little wider than the ribs. Periphery and the moderately long base well rounded, smooth, excepting the fine spiral striation which covers the entire surface of the shell. Aperture subquadrate, posterior angle acute; outer lip thin, showing the color bands within; columella slender, oblique, and slightly revolute.

The type (Cat. no. 126660, U.S.N.M.) was collected by Dr. C. F. Newcombe, at Victoria, Vancouver Island, British Columbia. It has seven post-nuclear whorls which measure: Length 5.4 mm., diameter 2.1 mm. Eighteen additional specimens were collected by Rev. G. W. Taylor at Port Simpson, British Columbia, 12 of which are in his collection, the other 6 form Cat. no. 196214, U.S.N.M.

TURBONILLA (PYRGOLAMPROS) TAYLORI Dall and Bartsch.

Plate 6, figs. 7, 7*a*.

Turbonilla (*Pyrgolampros*) *taylori* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 499, pl. 44, figs. 9, 9*a*.

Shell very regularly elongate-conic, purplish-brown. Entire surface marked by numerous closely placed minute spiral striations. Nuclear whorls small, depressed helicoid, smooth, scarcely at all immersed, having their axis at a right angle to that of the later turns, the sides not projecting beyond the outline of the spire. Post-nuclear whorls quite high between the sutures, only slightly contracted toward the periphery and very weakly beveled at the appressed summits, marked by low, broad, retractive axial ribs, which are much more numerous and less strongly defined on the early whorls than on those succeeding. There are about 36 on the second, 30 upon the third, 24 upon the fourth, and 26 upon the antepenultimate post-nuclear turn. On the last whorl they become irregular and irregularly spaced, showing senility. The ribs become flattened and less strongly defined toward the summit and the periphery, disappearing at the well-rounded periphery. Sutures well marked. Base short, inflated, rounded. Aperture suboval, somewhat effuse anteriorly; posterior angle acute; outer lip thin, white edged, chestnut brown within except at the very base, which is white; columella slender, twisted, and slightly revolute anteriorly.

The above description is based upon two cotypes (Cat. no. 196210, U.S.N.M.); one, an immature specimen having the nucleus and 9 post-nuclear whorls measures: Length 6.5 mm., diameter 1.9 mm., the other an adult individual having 10 whorls is minus the nucleus and probably the first five post-nuclear turns, and measures: Length 11.5 mm., diameter 3.1 mm.

The two cotypes and 30 specimens were collected by the Rev. G. W. Taylor at Departure Bay, British Columbia. The cotypes and five specimens are in the U. S. National Museum (Cat. no. 196210). The rest are in the Taylor collection.

This species was collected at five additional stations in British Columbia by the Rev. G. W. Taylor, all the specimens being in his collection except where otherwise stated. One specimen at Carter Bay; 3 at Port Simpson, 1 of which is Cat. no. 196211, U.S.N.M.; 11 at Banks Island, 3 of which are Cat. no 196212, U.S.N.M.; 6 at Alert Bay, 2 of which are Cat. no. 196213, U.S.N.M.

TURBONILLA (PYRGOLAMPROS) LOWEI Dall and Bartsch.

Plate 6, figs. 11, 11*a*.

Turbonilla (*Pyrgolampros*) *lowei* DALL and BARTSCH, Mem. Cal. Acad., vol. 3, 1903, p. 278, pl. 1, figs. 5, 5*a*.

Shell elongate-conic, uniformly light brown. Nuclear whorls two, small, depressed, helicoid, having their axis almost at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Early post-nuclear whorls increasing but little in diameter, rather high between the sutures, ornamented by very slender, somewhat sinuous, almost vertical axial ribs. Later whorls increasing more rapidly in diameter, less elevated between the sutures, ornamented by low, broad, rounded, almost vertical axial ribs, which become decidedly enfeebled as they approach the summit. There are almost 40 axial ribs upon the first, 34 upon the second, 30 upon the third, 25 upon the fourth, 20 upon the fifth to eleventh, and 22 upon the penultimate whorl. Intercostal spaces mere lines, on the first whorl, on the later ones shallow impressed areas of about half the width of the ribs. Sutures well marked. Periphery of the last whorl inflated. Base short, well rounded, posterior portion marked by the very feeble extensions of the axial ribs; the anterior smooth, excepting the very fine and exceedingly closely spaced spiral striations, which cover the entire surface of the shell. Aperture subquadrate; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, slightly twisted.

The type and four additional specimens (Cat. no. 152751*a*, U.S.N.M.), were collected by Mr. H. N. Lowe, in 10 fathoms off San Pedro, California. The type has lost the nucleus. The ten remaining whorls measure: Length 7.2 mm., diameter 2.2 mm. Cat. no. 204941, U.S.N.M., was dredged by Mrs. Oldroyd, in 4 fathoms off San Pedro. Cat. no. 159982, U.S.N.M., one specimen from San Pedro. Cat. no. 163257, U.S.N.M., San Pedro, collected by Mrs. Oldroyd. Cat. no. 205948, U.S.N.M., one specimen from Pacific Beach, collected by Mr. Henry Hemphill. One (Cat. no. 206864) dredged at U. S. Bureau of Fisheries, station 4345, in 25 fathoms, gray sand bottom, off Point Loma, California.

TURBONILLA (PYRGOLAMPROS) HALIBRECTA, new species.

Plate 5, figs. 10, 10*a*.

Shell elongate-conic. Nuclear whorls two, depressed, helicoid, having their axis at nearly right angles to that of the succeeding turns, in the first of which they are very slightly immersed. Post-nuclear whorls flattened in the middle, slightly rounded toward the somewhat shouldered summit and the periphery, marked by strong, rounded, almost vertical axial ribs, of which there are 20 on the first to fifth, 18 upon the sixth, and 16 upon the remaining turns. Intercostal spaces a little wider than the ribs, well impressed, sutures strongly marked. Periphery of the last whorl well rounded, marked by the feeble continuations of the axial ribs. Base short, well rounded. Entire surface of spire and base marked by exceedingly fine, closely crowded, spiral striations. Aperture rather small, oval; posterior angle acute; columella short and curved.

The type (Cat. no. 205950 U.S.N.M.) was collected off Catalina Island. It has 9 post-nuclear whorls and measures: Length 6.2 mm., diameter 1.7 mm.

TURBONILLA (PYRGOLAMPROS) GOULDI, new species.

Plate 6, figs. 1, 1*a*.

Shell slender, light brown. Nuclear whorls small, two, depressed, helicoid, having their axis almost at right angles to that of the succeeding turns, in the first of which they are slightly immersed. Post-nuclear whorls increasing regularly in size, marked by low, rounded, feebly developed axial ribs, of which there are 24 upon the second to fourth, 20 upon the fifth to eighth, 22 upon the ninth and penultimate turn. Intercostal spaces narrow and shallow. Sutures moderately impressed. Periphery of the last whorl well rounded, somewhat inflated. Base short, inflated. Entire surface of spire and base covered by numerous fine, closely spaced, wavy spiral striations. Aperture oval; posterior angle acute; outer lip thick within, thin at edge; columella moderately long, sinuous, and slightly reflected.

The above description is based on two cotypes, one (Cat. no. 163256*a* U.S.N.M.) from San Pedro, California, has furnished the description of the nucleus and early whorls, the other (Cat. no. 159990, U.S.N.M.) also from San Pedro, consisting of the last seven whorls, has furnished the adult characters. The young specimen has 9 post-nuclear whorls and measures: Length, 5.8 mm., diameter 2 mm. The adult specimen measures: Length 6.1 mm., diameter 2 mm.

Cat. no. 162561, U.S.N.M., contains a fragment collected by Henry Hemphill at Pacific Beach. Cat. no. 163256, U.S.N.M., nine specimens from San Pedro, collected by Mrs. Oldroyd. Cat. no. 163258, U.S.N.M., one specimen, dredged by the U. S. Bureau of Fisheries at station 2900, in 13 fathoms, off Santa Rosa Island. Another specimen was dredged by the University of California at station 59, off San Diego, California. Twelve specimens were identified for Mrs. Oldroyd from San Pedro.

Named for the late Doctor A. A. Gould.

TURBONILLA (PYRGOLAMPROS) AURANTIA Carpenter.

Plate 6, fig. 4.

Chemnitzia (? var.) *aurantia* CARPENTER, Journ. de Conch., vol. 12, 1865 (3d ser.), vol. 5, p. 147. *Turbonilla* (*Pyrgolampros*) *aurantia* (CARPENTER) DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 502, 503, pl. 45, fig. 5.

Shell similar to *T.* (*P.*) *chocolata* Carpenter, but much broader, with the close spiral striation a little more pronounced than in that species, covered by a golden-yellow epidermis. Nuclear whorls decollated in all our specimens. Post-nuclear whorls moderately rounded, but little contracted at base and but very slightly shouldered at the summit, ornamented by about 22 moderately developed, slightly retractive axial ribs on each of the whorls. These ribs become quite obsolete as they pass over the well-rounded periphery and base of the last whorl. Intercostal spaces weak, much narrower than the ribs. Sutures quite prominent, simple. Aperture large, broadly ovate, posterior angle obtuse, somewhat effuse at base; outer lip thin, columella slender, quite oblique, twisted, and revolute.

Doctor Carpenter's type (Cat. no. 4493*b*, U.S.N.M.), upon which the description is based, has 6 post-nuclear whorls and measures: Length 5.8 mm., diameter 2.4 mm. It bears the two localities Puget Sound and Santa Barbara, and probably comes from Puget Sound.

Three other specimens (Cat. no. 126660, U.S.N.M.) were collected by Dr. C. F. Newcombe at Victoria, Vancouver Island, British Columbia, and five more by the Rev. G. W. Taylor at Departure Bay, British Columbia, one of which is Cat. no. 196205, U.S.N.M., the others being in the Taylor collection. This one has 9 whorls remaining and measures: Length 9.5 mm., diameter 2.8 mm.

TURBONILLA (PYRGOLAMPROS) PEDROANA Dall and Bartsch.

Plate 6, figs. 12, 12*a*.

Turbonilla (*Pyrgolampros*) *lowei pedroana* DALL and BARTSCH, Mem. Cal. Acad., vol. 3, 1903, p. 279, pl. 2, figs. 3, 3*a*.

Shell elongate-conic, posterior two-thirds between the sutures light brown, anterior third and base darker, the two areas being separated by a still darker narrow band. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle, rounded toward the summit and the suture, ornamented by broad, low, well rounded, slightly protractive axial ribs, which become slightly flattened toward the summit; of which 16 appear upon the first and second, 18 upon the third to fifth, 20 upon the sixth, 22 upon the seventh and the penultimate turn. Intercostal spaces almost as wide as the ribs, shallow. Sutures well impressed. Periphery and the rather short base of the last whorl somewhat inflated and well rounded. Entire surface of spire and base marked by well incised, closely spaced, fine, spiral striations; aperture rather small, oval; posterior angle acute; outer lip thin, showing the external sculpture and coloration within; columella sigmoid, slender and slightly revolute.

The type (Cat. no. 15275, U.S.N.M.) and three additional specimens were dredged in 10 fathoms off San Pedro, California. The type has 10 post-nuclear whorls and measures: Length 7 mm., diameter 2.3 mm. Cat. no. 163255, U.S.N.M., contains three specimens collected at San Pedro by Mrs. Oldroyd. One specimen, Cat. no. 206865, U.S.N.M., dredged at U. S. Bureau of Fisheries station 4309, in 67 to 78 fathoms, on fine sand and broken shell bottom, 9 miles off Point Loma Light, California.

TURBONILLA (PYRGOLAMPROS) HALIA, new species.

Plate 5, fig. 11.

Shell elongate-conic, wax-yellow at the summit, grading to brown at the suture; anterior part of base, wax-yellow. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle, rounding gently toward the summit and the suture, marked by low, broad, well rounded, slightly protractive axial ribs, of which 16 occur upon the second, 18 upon the third and fourth, 20 upon the fifth to seventh, 24 upon the eighth, and 28 upon the penultimate turn; upon this they are less regular, somewhat enfeebled and retractive. Intercostal spaces a little narrower than the ribs. Sutures well impressed. Periphery of the last whorl well rounded. Base moderately long, well rounded. Entire surface of spire and base marked by numerous fine, crowded, wavy spiral striations. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture and coloration within; columella slender, slightly curved and revolute; parietal wall covered by a thin callus.

The type (Cat. no. 59328, U.S.N.M.) was collected at San Diego, California. It has 10 post-nuclear whorls and measures: Length 8.5 mm., diameter 2.5 mm.

Cat. no. 205946, U.S.N.M., contains a specimen collected by Mr. H. N. Lowe in 8 fathoms off San Pedro. Cat. no. 205947, U.S.N.M., two additional specimens from the same gentleman, collected in 10 fathoms off San Pedro. One specimen in Mr. S. S. Berry's collection comes from Santa Barbara, California.

TURBONILLA (PYRGOLAMPROS) LYALLI Dall and Bartsch.

Plate 6, figs. 6, 6*a*.

Turbonilla (*Pyrgolampros*) *lyalli* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 500, 501, pl. 44, figs. 4, 4*a*.

Shell small and slender with strong sculpture, whitish with a broad chestnut band which extends almost halfway over the exposed portion of the whorls above the periphery and an equal distance anteriorly over the base below the periphery. Nuclear whorls two, closely appressed to each other, forming a polished depressed helicoid spire, which does not extend beyond the outline of the post-nuclear spire, is not at all immersed and has its axis at right angles to the axis of the succeeding turns. Post-nuclear whorls decidedly flattened, moderately contracted at the periphery, and slightly shouldered at the summit, ornamented by strongly elevated, moderately broad, rounded retractive axial ribs, which become somewhat flattened toward the summit and periphery of the turns. There are about 22 ribs upon the second, 20 upon the fifth and the penultimate turn. Upon the first they are very weakly expressed. Intercostal spaces broad, almost double the width of the ribs. Sutures strongly impressed. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs which extend feebly to the umbilical region. Entire surface marked by numerous closely placed spiral striations. Aperture pyriform, posterior angle acute, columella almost straight, obliquely inserted, slightly revolute.

The unique type (Cat. no. 196221, U.S.N.M.) was collected by Rev. G. W. Taylor at Banks Island, British Columbia. It has 9 post-nuclear turns and measures: Length 5.7 mm., diameter 1.4 mm.

TURBONILLA (PYRGOLAMPROS) BERRYI Dall and Bartsch.

Plate 6, figs. 5, 5*a*.

Turbonilla (*Pyrgolampros*) *berryi* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 500, pl. 44, figs. 10, 10*a*.

Shell slender, very regularly acutely conic, bright chestnut-brown, with two narrow spiral bands of a lighter shade; one, the narrower of the two, is at the periphery, the other has its posterior edge at about the middle of the exposed portion between the sutures. Nuclear turns two and one-fourth, smooth, depressed, helicoid, not immersed, having their axis at a right angle to the axis of the later whorls, their sides projecting slightly beyond the outlines of the spire. Post-nuclear whorls very high between the sutures, slightly beveled at the summit and moderately constricted at the periphery, ornamented by well-developed, acute, retractive axial ribs, of which there are about 20 upon the second, 24 upon the fifth, and 26 upon the penultimate turn. These ribs extend quite strongly to the summit, where they feebly crenulate the well-impressed sutures. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs, which gradually disappear as they cross the base. Entire surface marked by numerous very fine, closely spaced, wavy, spiral striation. Aperture suboval, somewhat effuse anteriorly; posterior angle acute; columella oblique, very slightly twisted and weakly revolute at its outer extremity.

The type (Cat. no. 196223, U.S.N.M.) has 9 post-nuclear whorls and measures: Length 8 mm., diameter 2.2 mm. It and another specimen in Mr. S. S. Berry's collection were dredged by him in 39 fathoms on sandy bottom in Monterey Bay.

Another specimen (Cat. no. 196225, U.S.N.M.) was dredged by the Bureau of Fisheries steamer *Albatross*, at station 4564, in 9 to 10 fathoms, rocky bottom, with a temperature of 59°, 2 miles off Santa Cruz Light, Monterey Bay, California.

A fourth shell (Cat. no. 196224, U.S.N.M.) was dredged in 52 fathoms, off Catalina Island, California.

TURBONILLA (PYRGOLAMPROS) ALASKANA, new species.

Plate 6, fig. 9.

Shell elongate-conic, wax yellow, with a broad, peripheral, light-brown band and a narrow one immediately below the summit; these are best seen in the aperture. (Nuclear whorls decollated in all our specimens.) Post-nuclear whorls increasing very slowly in diameter in the first three turns, then more rapidly. The summits of succeeding turns fall a little below the periphery, which gives the whorls an overhanging appearance. The whorls are marked by very strong, well elevated, broad, rounded, irregularly slanting axial ribs which become slightly widened and flattened both at the summit and at the periphery. There are about 18 of them upon all but the last turn; upon this there are about 22. Intercostal spaces about as wide as the axial ribs. Sutures strongly impressed. Periphery of the last whorl somewhat angulated, base moderately long, well rounded, marked by feeble extensions of the axial ribs and many fine, closely spaced, wavy spiral striations; the latter also mark the spaces between the sutures. Aperture moderately large, ovate, posterior angle acute; outer lip moderately thick; columella oblique, curved andstrongly revolute; parietal wall covered by a strong callus.

The type and seven specimens (Cat. no. 160206, U.S.N.M.) were collected at St. Paul, Kadiak, Alaska, in 13 fathoms, mud bottom, by Dr. W. H. Dall. The type has lost the nucleus and probably the first one and one-half post-nuclear turns. The nine remaining measure: Length 8 mm., diameter 2.6 mm. The following specimens were all collected by Doctor Dall (Cat. no. 205149, U.S.N.M.). Nine specimens from Chagafka Cove, Kadiak, Alaska; (Cat. no. 205150 U.S.N.M.), one specimen from Granite Cove, Port Althorp, Alaska, in 8 fathoms on sand bottom; (Cat. no. 160209, U.S.N.M.) three specimens from Sitka Harbor, Alaska, in 12 fathoms on mud and gravel bottom.

TURBONILLA (PYRGOLAMPROS) CHOCOLATA Carpenter.

Plate 5, figs. 9, 9*a*.

Chemnitzia chocolata CARPENTER, Proc. Cal. Acad. Sci., 1865, p. 220.

Shell slender, elongate-conic, uniformly golden-brown, shining. Nuclear whorls very small, planorboid, two and one-half, having their axis at right angles to that of the succeeding turns; not immersed. Post-nuclear whorls rather high between the sutures, slightly shouldered at the summit, flattened on the posterior three-fourths between the sutures; rounding on the anterior fourth to the somewhat contracted suture. Axial ribs slightly retractive, well rounded, 22 upon the first eight whorls, 24 upon the ninth, and 28 upon the tenth; on the penultimate whorl they are poorly developed, split, and otherwise indicating a senile stage. Sutures well impressed. Periphery and base of the last whorl inflated and well rounded. The entire surface of the base and spire marked by numerous fine, wavy, closely spaced spiral striations. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; also three bands of color upon a bluish-white surface, one immediately below the summit, another covering the part corresponding to posterior half of the base, and a narrow one dividing the space between these two areas in equal halves; columella curved, moderately strong, and revolute.

The specimen described and figured (Cat. no. 15315, U.S.N.M.) was collected by J. C. Cooper at San Pedro, California. It has 12 post-nuclear whorls and measures: Length 14 mm., diameter 3.6 mm.

TURBONILLA (PYRGOLAMPROS) PAINEI, new species.

Plate 5, figs. 4, 4*a*.

Shell very slender, horn-yellow with a chestnut band about two-fifths the width of the space between the sutures immediately below the summits, and another about one-third as wide dividing the light area of the spire into equal parts. Posterior half of base chestnut brown, anterior horn-yellow. Nuclear whorls small, two and one-fourth, depressed, helicoid, having their axis almost at right angles to that of the succeeding turns, in the first of which they are slightly immersed. Post-nuclear whorls slightly shouldered at the summit, weakly rounded, marked by strong, well rounded retractive axial ribs, of which 24 occur upon the first, 22 upon the second, 20 upon the third to fifth, and 22 upon the sixth to penultimate turn. Sutures well impressed, rendered somewhat wavy by the strong terminations of the ribs at the summit of the whorls. Periphery of the base inflated, well rounded. Base moderately long, well rounded, marked by the feeble continuations of the axial ribs. Entire surface of base and spire bearing fine, closely crowded, wavy spiral striations. Aperture large; posterior angle acute; outer lip thin, showing the external sculpture and color markings within; columella slender, straight, oblique, and slightly revolute.

The type (Cat. no. 205952, U.S.N.M.) was collected near Redondo, California. It has nine post-nuclear whorls and measures: Length 7.3 mm., diameter 2.2 mm. Cat. no. 171911, U.S.N.M., contains another specimen collected by S. S. Berry and J. H. Paine in 50 fathoms off Avalon, Catalina Island. Cat. no. 205953, U.S.N.M., one specimen collected by Mr. F. W. Kelsey in 35 fathoms off Coronado Hotel, San Diego; and Cat. no. 203507, U.S.N.M., one specimen collected by Mr. C. W. Gripp at San Diego, California.

Named for J. H. Paine.

TURBONILLA (PYRGOLAMPROS) KEEPI, new species.

Plate 5, fig. 1.

Shell elongate-conic, yellowish-white with a brown band about two-fifths the width of the space between the sutures, immediately below the summits, and one about one-third as wide, a little anterior to the middle of the remaining light area. Posterior half of base a little lighter brown than the bands between the sutures, grading into white on the anterior half. (Nuclear whorls decollated.) Post-nuclear whorls slightly shouldered, flattened, somewhat contracted at the periphery, marked by strong, well rounded, almost vertical axial ribs, of which there are 22 upon the fourth to sixth, 24 upon the seventh to ninth, 26 upon the tenth, and 30 upon the penultimate turn. Intercostal spaces a little narrower than the ribs, well impressed. Sutures strongly impressed, rendered sinuous by the strong terminations of the axial ribs at the summits of the whorls. Periphery of the last whorl well rounded. Base moderately long, well rounded. Entire surface of spire and base marked by numerous, very closely crowded, wavy, spiral striations. Aperture large; posterior angle acute; outer lip thin, showing the external sculpture and color bands within; columella very oblique, almost straight and slightly revolute.

The type (Cat. no. 173080, U.S.N.M.) was collected by Mr. Lowe at Long Beach, California. It has lost the nucleus and the first three post-nuclear whorls. The nine remaining measure: Length 11.7 mm., diameter 3.5 mm. The University of California has obtained this species at the following stations: 14 (3) off Point Firmin; 21 (2) off Catalina Island; 32 off Catalina Island; 73 off San Diego, California.

Named for Prof. Josiah Keep.

TURBONILLA (PYRGOLAMPROS) HALISTREPTA, new species.

Plate 5, fig. 2.

Shell elongate-conic, wax yellow with a broad subsutural, narrow submedian and a broad subperipheral band of golden brown. (Nuclear whorls decollated.) Post-nuclear whorls rather high between the sutures, very slightly shouldered, marked by almost obsolete, nearly vertical axial ribs, which are best developed near the summit and practically disappear before they reach the suture on the early whorls; on the last three they are scarcely indicated. Of these ribs there are about 28 upon the third and 24 upon the seventh whorl. Sutures well impressed. Periphery and the short base of the last whorl somewhat inflated, well rounded. Entire surface of spire and base marked by many well incised, closely spaced, wavy, spiral striations. Some of the fine lirations between the incised lines are a little darker colored than the rest of the surface and appear as reddish-brown hair lines. Aperture oval; posterior angle acute; outer lip thin, showing the external markings within; columella slender, strongly curved and moderately revolute.

The type (Cat. no. 205954, U.S.N.M.) was dredged by the University of California, off Newport, California. It has lost the nucleus and probably the first post-nuclear whorl; those remaining measure: Length 9.5 mm., diameter 2.7 mm. Two topotypes are in the collection of the University of California.

TURBONILLA (PYRGOLAMPROS) LITUYANA, new species.

Plate 5, fig. 8.

Shell elongate-conic, light wax yellow, with a supra and subperipheral light chestnut band, separated by a very narrow, dark wax yellow peripheral zone. (Nuclear whorls decollated.) Post-nuclear whorls rather high between the sutures, early ones with moderately strong, broad, low, almost vertical axial ribs, which become quite obsolete on the last turn and a half. About 22 of these ribs appear upon the eighth whorl. Intercostal spaces narrow and weakly impressed. Sutures well rounded. Periphery and base of the last whorl well rounded, the latter marked by continuations of the obsolete riblets and the fine, close, wavy spiral striations which also cover the entire surface of the spire. Aperture oval; posterior angle acute; outer lip thin; columella slender, oblique, slightly curved and revolute, with a slight fold at its insertion; parietal wall covered by a thin callus.

The type (Cat. no. 160208, U.S.N.M.) was collected by Dr. W. H. Dall, at Lituya Bay, Alaska. It has the last nine post-nuclear whorls, having lost the nucleus and probably the first two post-nuclear turns, and measures: Length 11.5 mm., diameter 3.7 mm. Two additional specimens (Cat. no. 160207, U.S.N.M.) were also collected by Doctor Dall in the same locality, in 8 fathoms, on sandy bottom.

TURBONILLA (PYRGOLAMPROS) OREGONENSIS Dall and Bartsch.

Plate 5, fig. 5.

Turbonilla (*Pyrgolampros*) *oregonensis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 503, 504, pl. 45, fig. 2.

Shell elongate-conic, wax yellow, with two yellowish-brown spiral bands, the posterior one of which encircles the turns a little above the periphery, while the anterior one, which is a little wider, is immediately posterior to it, the two being separated by a space about as wide as the posterior band. (Nuclear whorls decollated in all our specimens.) Post-nuclear turns very slightly rounded, moderately contracted at the periphery, and closely appressed to the preceding turn at the summit. There are no well-defined ribs, the axial sculpture being reduced to mere lines of growth, with here and there a weakly impressed area, probably representing an obsolete intercostal space. Sutures strongly impressed. Periphery of the last whorl faintly angulated. Base short, well rounded. Entire surface marked by fine, regular, close, spiral striation. Aperture pyriform, posterior angle acute; outer lip thin, columella somewhat twisted, scarcely revolute at its free end.

The type has 8½ whorls remaining which measure: Length 8.5 mm., diameter 2.7 mm. It and another specimen (Cat. no. 181112, U.S.N.M.) were dredged by the U. S. Bureau of Fisheries steamer *Albatross* at station 2885, off Oregon, in 30 fathoms, with a bottom temperature of 49°.

Another specimen (Cat. no. 196222, U.S.N.M.) was dredged at station 2868, off the coast of Washington, in 31 fathoms, on gray sand, with a bottom temperature of 46.9°.

Subgenus PYRGISCUS Philippi.

Pyrgiscus Philippi, Wieg. Arch., vol. 1, 1841, p. 50. Type, *Melania rufa* Philippi = *Pyrgostelis* Monterosato, Conch. Medit., 1884, p. 89, same type = *Ortostelis* Aradas, Atti Dell Acad. Giov. di Catania, 1843, vol. 20, same type.

Turbonillas having prominent axial ribs and deeply incised spiral lines, but no varices or internal lirations on the outer lip. Columella usually somewhat flexuous.

Type.—*Melania rufa* Philippi.

KEY TO THE SPECIES OF THE SUBGENUS PYRGISCUS.

- Base without spiral sculpture.
  - Shell with a tuberculate cord near the summit.................... *annettæ*, p. 76.
  - Shell without tuberculate cord near the summit................ *gracillima*, p. 77.
- Base with spiral sculpture.
  - Axial ribs terminating abruptly at the periphery.
    - Shell broadly conic.
      - Incised spirals between the sutures 6 of uniform strength.. *vexativa*, p. 77.
      - Incised spirals between the sutures 7 not of uniform strength. *obesa*, p. 78.
    - Shell elongate-conic.
      - Incised spirals between the sutures of uniform strength.... *favilla*, p. 78.
      - Incised spirals between the sutures not of uniform strength.
        - Spiral lines 5 strong and 3 slender................. *pequensis*, p. 79.
        - Spiral lines 7 strong and 6 slender.................. *nuttingi*, p. 79.
        - Spiral lines 2 strong and 11 slender..................... *callia*, p. 80.
        - Spiral lines 2 strong and 20 slender................. *superba*, p. 80.
  - Axial ribs passing feebly over the periphery, but evanescing before they reach the middle of the base.
    - Shell stout and very robust.
      - Axial ribs somewhat tuberculate.......................... *pluto*, p. 81.
      - Axial ribs not tuberculate.............................. *jewetti*, p. 82.
    - Shell broadly conic.
      - Incised spiral lines between the sutures of uniform strength.
        - Incised spirals between the sutures 6.................. *signæ*, p. 83.
        - Incised spirals between the sutures 7.
          - Intercostal spaces about as wide as the ribs....... *striosa*, p. 83.
          - Intercostal spaces double the width of the ribs.
            - Base with 13 well-incised spiral lines only... *morchi*, p. 84.
            - Base with 15 well-incised lines and narrow spiral striations......................... *aragoni*, p. 85.
        - Incised spirals between the sutures 8.................... *recta*, p. 85.

- Base with spiral sculpture—Continued.
  - Axial ribs passing feebly over the periphery, but evanescing before they reach the middle of the base—Continued.
    - Shell broadly conic—Continued.
      - Incised spirals between the sutures not of uniform strength.
        - Incised lines between the sutures all strong.
          - Incised spirals between the sutures 8.............. *weldi*, p. 86.
          - Incised spirals between the sutures 9............. *nereia*, p. 86.
        - Incised lines between the sutures partly strong and partly fine.
          - Base with 11 well-incised spiral lines..... *antestriata*, p. 87.
          - Base with 9 slender and numerous microscopic lines.......................... *antemunda*, p. 88.
    - Shell elongate-conic.
      - Incised spiral lines between the sutures of uniform strength.
        - Spiral striations between the sutures more than 10.
          - Whorls well rounded....................... *flavescens*, p. 89.
          - Whorls flattened.
            - Spiral striations between the sutures 15.... *macbridei*, p. 90.
            - Spiral striations between the sutures 30...... *nuttalli*, p. 90.
        - Spiral striations between the sutures less than 10.
          - Spiral striations between the sutures 5........ *macra*, p. 91.
          - Spiral striations between the sutures 6....... *angusta*, p. 91.
      - Incised spiral lines between the sutures not of uniform strength.
        - Incised spiral lines between the sutures all strong.
          - Summits of the whorls excurved.............. *tenuicula*, p. 92.
          - Summits of the whorls not excurved.
            - Spacing regular.
              - Incised spirals 6 strong and 1 fine......... *virgo*, p. 93.
              - Incised spirals 7 strong and 3 fine...... *marshalli*, p. 94.
            - Spacing irregular.
              - Whorls flattened...................... *canfieldi*, p. 95.
              - Whorls well rounded..................... *almo*, p. 95.
      - Incised spirals between the sutures consisting of well-impressed pits or lines and fine striations.
        - Spiral markings consisting of two strong series of pits, one the peripheral, the other the sub or supra-median and many fine striations.
          - Whorls strongly shouldered.
            - Incised spiral lines between the two pits 18. *callipeplum*, p. 96.
            - Incised spiral lines between the two pits 12.... *dina*, p. 96.
          - Whorls not shouldered.
            - Whorls exserted at the summit.............. *shimeki*, p. 97.
            - Whorls not exserted at the summit........ *sanctorum*, p. 98.
        - Spiral markings consisting of more than two series of strong pits or lines and wavy fine striations.
          - Whorls exserted at the summit................ *tenuicula*, p. 92.
          - Whorls not exserted at the summit.
            - Shell large, adult more than 11 mm.... *eucosmobasis*, p. 98.
            - Shell smaller, adult less than 7 mm....... *halidoma*, p. 99.
  - Axial ribs extend over the base to the umbilical area.
    - Base of the last whorl very decidedly inflated.
      - Adult shell less than 8 mm. long...................... *auricoma*, p. 100.
      - Adult shell more than 10 mm. long .... *castanea*, p. 101.

- Base with spiral sculpture—Continued.
  - Axial ribs extend over the base to the umbilical area—Continued.
    - Base of the last whorl not decidedly inflated.
      - Shell very large, adult more than 13 mm.............. *castanella*, p. 102.
      - Shell less than 10 mm.
        - Incised spiral lines between the sutures of uniform strength.
          - Whorls strongly shouldered.................... *indentata*, p. 102.
          - Whorls not strongly shouldered.
            - Incised spirals between the sutures 3........... *cora*, p. 103.
            - Incised spirals between the sutures 7.
              - Axial ribs 14–22.................... *craticulata*, p. 104.
              - Axial ribs 36–40......................... *ceralva*, p. 104.
            - Incised spirals between the sutures 8, or 8 on the early turns and 10 on the later ones.
              - Basal striations 5......................... *lepta*, p. 105.
              - Basal striations 12........... .... *histias*, p. 105.
            - Incised spirals between the sutures 9........ *subula*, p. 106.
      - Incised spiral lines between the sutures not of uniform strength.
        - Incised lines between the sutures all strong.
          - Shell large, adult more than 8 mm. long..... *wickhami*, p. 106.
          - Shell small, adult less than 6 mm. long.
            - Incised spiral lines between sutures 9......... *lara*, p. 107.
        - Incised spirals between the sutures consisting of strongly impressed pits or lines and fine striations.
          - Spiral pits 2, one peripheral and one median, fine lines 28. *cinctella*, p. 108.
          - Spiral pits 5, fine lines 5......................... *adusta*, p. 108.
          - Spiral pits 7, fine lines 4...................... *larunda*, p. 109.

TURBONILLA (PYRGISCUS) ANNETTÆ, new species.

Plate 7, fig. 7.

Shell very thin and delicate, yellowish-white. (Nuclear whorls decollated.) Post-nuclear whorls concave with a tuberculated shoulder a little below the summit, marked by strong, sinuous, slender, almost vertical axial ribs, of which 18 occur upon all but the penultimate whorl, the latter having 20. Intercostal spaces about four times as wide as the ribs, marked by seven broad, incised, spiral pits. The space between the first and second pit below the summit forms a rather strong raised spiral cord, the junction of which with the ribs renders them tuberculate. Periphery of the last whorl angulated. Base well rounded, marked by the feeble continuations of the axial ribs only. Aperture rhomboidal; posterior angle acute; outer lip thin, showing the external markings within; columella slender, curved and slightly revolute.

The type (Cat. no. 163265, U.S.N.M.) and another specimen were dredged at U. S. Bureau of Fisheries station 2792 in 401 fathoms, off Manta, Ecuador.

The type has the last six and one-half whorls and measures: Length 3.7 mm., diameter 1.3 mm.

TURBONILLA (PYRGISCUS) GRACILLIMA Carpenter.

Plate 7, fig. 9.

Chemnitzia gracillima CARPENTER, Cat. Mazatlan Shells, 1856, p. 431; not *Turbonilla gracillima* GABB, 1865, nor *Turbonilla gracillima* KOCH and WIECHMANN, 1872, not *Turbonilla gracillima* ALMERS and BOFILL, 1898.

Shell very slender, acute, milk-white. Nuclear whorls prolonged, partly lost. Post-nuclear whorls well rounded at first, later flattened, moderately contracted at the periphery and slightly shouldered at the summit, marked by slender, almost vertical, axial ribs, of which 12 occur upon the first, 14 upon the second and third, 16 upon the fourth, 18 upon the fifth and penultimate turn. Intercostal spaces as broad as the ribs, terminating suddenly at the periphery, crossed by about fourteen equal and equally spaced spiral pits, which are equal to the spaces which separate them. Periphery and base of the last whorl well rounded, without sculpture, smooth. Aperture rhomboidal; posterior angle obtuse; outer lip thin; columella slender, somewhat twisted.

Two specimens were collected off *Chama* at Mazatlan, Mexico; the larger of these has eight post-nuclear whorls, and measures: Length 3 mm., diameter 0.9 mm., and is on tablet 2001, Liverpool collection, British Museum.

TURBONILLA (PYRGISCUS) VEXATIVA, new species.

Plate 7, fig. 11.

Shell stout, chestnut brown. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle, slightly rounded toward the appressed summit, and weakly contracted at the periphery, marked by weak, rounded, vertical axial ribs, which terminate abruptly at the periphery, of which 22 occur upon the fifth, 24 upon the sixth and seventh, and 26 upon the penultimate turn. Intercostal spaces about one and one-half times as wide as the ribs, marked by six equal and equally spaced spiral grooves, which divide the space between the sutures into seven equal parts. Sutures well impressed. Periphery of the last whorl angulated. Base short, marked by eight strongly incised spiral lines, which decrease in spacing from the periphery to the umbilical area. The space immediately behind the columella bears a number of closely spaced, fine, spiral striations. Aperture rhomboidal; posterior angle obtuse; outer lip thin, showing the external markings within; columella slender, somewhat twisted and slightly revolute.

The type (Cat. no. 160200, U.S.N.M.) was collected by Mr. E. W. Roper at San Pedro, California. It has lost the nucleus. The nine remaining whorls measure: Length 6.2 mm., diameter 2.1 mm.

TURBONILLA (PYRGISCUS) OBESA, new species.

Plate 7, figs. 3, 3*a*.

Shell robust, chocolate brown. Nuclear whorls small, deeply obliquely immersed in the first post-nuclear turn, above which only the tilted edge of the last one projects. Post-nuclear whorls flattened, moderately shouldered at the summit, marked by strong vertical axial ribs, which are decidedly contracted at their junctions with the spiral grooves, which lends them a somewhat nodulous aspect. Of these ribs, 16 appear on the first, 18 on the second, 20 upon the third to fifth, 22 on the sixth, and 24 on the penultimate turn. Intercostal spaces about as broad as the ribs, crossed by five strongly incised spiral grooves which almost cross the ribs. One of these is at the periphery. The remaining four appear in a double series; the one placed about as far below the summit as the other is above the periphery, the space between them being wider than that between the summit and the first pit below it. Two fine incised spiral lines mark the space between the summit and the first series of pits below it. Periphery of the last whorl marked by a broad plain band, well rounded. Base very short, well rounded, marked by about six unequal and unequally spaced strong incised lines. Aperture pear-shaped; posterior angle acute; outer lip thin, showing the external sculpture within; columella oblique, slightly revolute, provided with a moderately strong fold at its insertion.

The type (Cat. no. 162563 U.S.N.M.) was collected at Pacific Beach, California. It has eight post-nuclear whorls, and measures: Length 5.2 mm., diameter 1.8 mm.

TURBONILLA (PYRGISCUS) FAVILLA, new name.

Chemnitzia cœlata CARPENTER, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 400, not *Chemnitzia cœlata* GOULD, Proc. Bost. Soc. Nat. Hist., vol. 3, 1861, p. 406.

"Shell quite large, elongate, ashy. (Nuclear whorls decollated.) Post-nuclear whorls 13, flattened, separated by weakly impressed sutures. Axial ribs 20 to 28, straight, subacute, suddenly truncated at the periphery. Intercostal spaces marked by 4 to 5 deeply impressed spiral grooves, which pass up on the sides of the ribs but do not cross their summits. Periphery of the last whorl angulated. Base short, marked by 6 spiral lines. Aperture subquadrate; columella strongly twisted. Length 8.8 mm., diameter 2.3 mm."

The above is Doctor Carpenter's description, to which he adds: "This beautiful and unique shell was probably from Panama; but there was no locality mark. It is remarkable for its deep furrow and the suddenly shortened and spirally sculptured base. It is much larger and broader than the northern *C. virgo*, and differs in details of sculpture." We have not seen this species.

TURBONILLA (PYRGISCUS) PEQUENSIS, new species.

Plate 7, figs. 5, 5*a*.

Shell slender, light yellow, with a broad golden band encircling the whorls in the middle between the sutures, and another a little wider immediately posterior to the periphery. Nuclear whorls two, planorboid, having their axis almost at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Post-nuclear whorls flattened in the middle, with a strong sloping shoulder, which occupies about one-fifth of the space between the sutures; somewhat contracted at the periphery, marked by moderately strong, slightly protractive axial ribs, which are strongest at the angle of the shoulder and terminate at the periphery. Of these ribs there are 14 upon the first to third and 16 upon the remaining turns. Intercostal spaces almost as wide as the ribs, shallow, marked by eight equal, strongly incised, but unequally spaced spiral grooves; the three immediately posterior to the periphery being a little more closely spaced than the rest. Two feebly incised fine lines divide the space between the summit and the first strong line and that between the first and second. These fine lines are best shown on the last whorls. Sutures well impressed. Base short, well rounded, marked by about a dozen very fine, wavy spiral striations. Aperture rhomboid; outer lip thin, showing the external sculpture within; columella somewhat twisted, slightly revolute, provided with an oblique fold at its insertion.

The type (Cat. no. 97019, U.S.N.M.) has eight post-nuclear whorls, and measures: Length 4.6 mm., diameter 1.8 mm. It was collected at U. S. Bureau of Fisheries station 2834, near Point Abreojos, in 12 fathoms, on sand bottom, off Lower California.

TURBONILLA (PYRGISCUS) NUTTINGI, new species.

Plate 7, figs. 13, 13*a*.

Shell long and slender, wax yellow on the posterior half between the sutures, light brown on the anterior and the periphery. Nuclear whorls large, two and one-half, forming a depressed helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is about one-fifth immersed. Post-nuclear whorls moderately well rounded, slightly shouldered at the summit, marked by strong, broad, well rounded, somewhat protractive axial ribs, of which 20 occur upon the first to sixth, 22 upon the seventh to ninth, and 24 upon the penultimate turn. These ribs extend prominently from the summit to the periphery of the whorls, but do not cross the latter. Intercostal spaces very narrow, not more than half the width of the ribs; anterior half between the sutures marked by five equal and equally spaced spiral grooves; posterior half marked by two which equal those on the anterior half in strength, but are a little more distantly spaced, and six fine incised lines which divide the space posterior to the last groove. Sutures somewhat constricted. Periphery of the last whorl well rounded. Base short, well rounded, marked by nine slender incised spiral lines, which are successively a little closer spaced from the periphery to the umbilical region. Aperture rhomboid; posterior angle obtuse; outer lip thin, showing the external markings within; columella slender, somewhat curved and slightly revolute.

The type (Cat. no. 160067 U.S.N.M.) was dredged by Mr. F. W. Kelsey in twenty fathoms off San Diego. It has eleven post-nuclear whorls and measures: Length 12.3 mm., diameter 1.6 mm.

Named for Prof. C. C. Nutting.

The following specimens have been examined:

U. S. N. M. cat. no.	No. of specimens.	U. S. B. F. station.	Locality.	Depth, fathoms.	Disposition of material.
160067	1		Off San Diego, California	20	U. S. Nat. Mus.
173075	2		Northwest of San Diego, California.	50	Do.
152752	3		Off San Pedro, California	8	Do.
	1	28	Off San Diego, California		Univ. Cal. coll.
	1	28	San Diego, California	50	Kelsey coll.

TURBONILLA (PYRGISCUS) CALLIA, new species.

Plate 7, fig. 4.

Shell elongate-conic, yellowish-white. Nuclear whorls decollated. Post-nuclear whorls moderately well rounded, ornamented by rather weak, slightly protractive, axial ribs, of which 16 occur upon the first. four of the remaining turns and 18 upon the rest. Intercostal spaces shallow, double the width of the ribs, marked by two lines of pits, one of which is at the periphery, the other a little posterior to the middle of the whorls and a series of finer incised lines of which seven irregularly spaced ones occur between the two rows of pits and four between the upper row of pits and the summit. Sutures well impressed. Periphery of the last whorl well rounded. Base short, well rounded, marked by several well incised spiral striations. Aperture subquadrate; posterior angle obtuse; outer lip thin, strongly bent at its anterior margin; columella short, twisted and slightly revolute.

The type (Cat. no. 205936, U.S.N.M.) was collected at San Diego, California. It has lost the early whorls. The nine remaining measure: Length 4.7 mm., diameter 1.4 mm.

TURBONILLA (PYRGISCUS) SUPERBA, new species.

Plate 7, figs. 10, 10*a*.

Shell elongate-conic, pale yellow with a darker broad yellow band a little posterior to the middle of the whorls between the sutures, and another of about equal width at the periphery. Nuclear whorls one and three-fourths, moderately large, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Post-nuclear whorls well rounded, the strongest convexity falling a little anterior to the middle between the sutures, appressed at the summit, marked by strong, sublamellar, slightly protractive axial ribs, of which 16 occur upon the first to seventh whorl, 18 upon the eighth, 20 upon the ninth and the penultimate turn. Intercostal spaces about three times as wide as the ribs, shallow, marked by a series of deep spiral pits, at the periphery and another a little posterior to the middle of the whorls. The space between the peripheral and the median pits is crossed by ten unequal and unequally spaced, fine spiral striations. The space between the median row of pits and the summit is crossed by ten incised spiral lines of similar character. Sutures well impressed. Periphery of the last whorl slightly angulated. Base short, well rounded, marked by about thirteen fine, well incised, equal and equally spaced spiral striations. Aperture rhomboid; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella straight, oblique and revolute, provided with a weak fold at its insertion.

The type (Cat. no. 163261, U.S.N.M.) has eleven post-nuclear whorls and measures: Length 6.5 mm., diameter 1.6. mm. It and two additional specimens were dredged at U. S. Bureau of Fisheries station 2822, in 21 fathoms, gray sand and broken shells, off La Paz, Lower California.

TURBONILLA (PYRGISCUS) PLUTO, new species.

Plate 9, fig. 9.

Shell very robust, chestnut brown. (Nuclear whorls decollated.) Post-nuclear whorls flattened, moderately shouldered at the summit and scarcely at all contracted at the sutures, marked by rather irregular, low, rounded, variously slanting axial ribs which are completely eroded on the first four whorls, on the fifth and sixth there are 24, on the seventh and the penultimate there are 38. Intercostal spaces a little narrower than the ribs, marked by four spiral series of broad strongly impressed spiral pits, on the anterior two-thirds of the whorls between the sutures; the posterior third is marked by two closely spaced, well incised, strong spiral lines, the first of which is about as far posterior to the neighboring pit as the space which separates that from its fellow. Both spiral pits and lines cut strongly into the sides of the ribs and pass feebly over their summits, rendering them somewhat tuberculate. Sutures well impressed. Periphery of the last whorl marked by a plain band, well rounded. Base moderately long, well rounded, marked by the very feeble continuations of the axial ribs and six equal and equally spaced, broad and deeply incised spiral lines. Aperture pear shaped; posterior angle acute; outer lip rather thick; columella short, oblique and somewhat revolute.

The type (Cat. no. 206866, U.S.N.M.) was dredged in 10 fathoms, off San Pedro, California. It has nine post-nuclear whorls and measures: Length 7.5 mm., diameter 2.3 mm.

TURBONILLA (PYRGISCUS) JEWETTI, new species.

Plate 7, figs. 2, 2*a*.

Shell short, robust, rose pink, wax yellow at tip. Nuclear whorls two and one-half, very small, low, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-third immersed. Post-nuclear whorls flattened, shouldered at the summit, marked by strong, rounded, slightly protractive axial ribs; of which 18 occur upon the second, 20 upon the third, 22 upon the fourth and fifth, 24 upon the sixth, and 26 upon the penultimate turn. Intercostal spaces about equal to the ribs, strongly impressed, marked by five series of equal and equally spaced spiral pits, the first of which is at the periphery, the last a little farther from the summit than its neighbor. Sutures strongly marked, rendered sinuous by the ribs. Periphery of the last whorl rounded, marked by the feeble continuations of the axial ribs. Base moderately long, well rounded, marked by eight unequal and unequally spaced spiral striations, the two immediately below the periphery being stronger than the rest and somewhat interrupted. Aperture oval; outer lip thick within, columella stout, somewhat twisted and slightly revolute.

The type (Cat. no. 153048, U.S.N.M.) and another specimen were obtained at low tide at San Diego, California. The type has eight post-nuclear whorls and measures: Length 5.5 mm., diameter 1.9 mm.

Named for the late Col. Ezekiel Jewett.

We have examined the following specimens:

U.S.N.M. cat. no.	Number of specimens.	U. S. B. F. station.	Locality.	Depth, fathoms.	Disposition of material.
153048	2	....	Off San Diego, California..........	....	U. S. Nat. Mus.
163263	1	....	.... do..........	....	Do.
109519	1	....	Terminal Island, California..........	....	Do.
162564	1	....	Pacific Beach, California..........	....	Do.
152316	2	....	Ocean Beach, California..........	....	Do.
	1	....	Arch Beach, California..........	....	Univ. Cal. coll.
	1	....	San Pedro, California..........	....	Lowe coll.
46507	1	....	Todos Santos Bay, Lower California.	....	U. S. Nat. Mus.
162565	4	....	San Hipolito Point, Lower California.	....	Do.
162566	1	2835	Lower California..........	5.5	Do.

TURBONILLA (PYRGISCUS) SIGNÆ, new species.

Plate 7, fig. 1.

Shell elongate-conic, of very regular outline, wax yellow, variegated with ashy. (Nuclear whorls decollated.) Post-nuclear whorls very flat, with appressed summits, scarcely at all contracted at the periphery, marked by low, rounded, slightly sinuous, somewhat protractive axial ribs, of which 22 occur upon the second, 24 upon the third, 26 upon the fourth, 28 upon the fifth, 30 upon the sixth, 36 upon the seventh, 46 upon the eighth, and, of those remaining, the same number upon the penultimate turn. Intercostal spaces about half as wide as the ribs, marked by six equal and equally spaced spiral rows of pits, the last of which is at a little greater distance from the summit than its fellow. Sutures very faintly indicated. Periphery of the last whorl somewhat angulated. Base short, well rounded, marked by about a dozen fine, wavy, equal and equally spaced spiral lines. Aperture rhomboidal; outer lip thick; columella moderately strong, slightly sinuous and somewhat reflected.

The type (Cat. no. 160210, U.S.N.M.) was collected by Mr. Roper at San Pedro, California. It has lost the nucleus and probably the first three post-nuclear whorls. The ten remaining measure: Length 10.2 mm., diameter 2.7 mm.

TURBONILLA (PYRGISCUS) STRIOSA C. B. Adams.

Plate 7, figs. 8, 8*a*.

Chemnitzia striosa C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., 1852, p. 393.

Shell elongate-conic, wax yellow, nuclear whorls at least two, forming a planorboid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls moderately rounded, feebly shouldered at the summit, very slightly contracted at the sutures, marked by poorly developed axial ribs which are scarcely at all expressed on the first two whorls, and become decidedly weakened and irregular on the last. Of these ribs there are 24 upon the third to fifth, 26 upon the sixth, and 28 on the seventh whorl. Intercostal spaces as irregular as the ribs and usually a little wider, marked by six equally strong, and equally spaced, incised spiral lines, which become quite irregular on the last whorl. Sutures well impressed. Periphery and base of the last whorl well rounded, the latter marked by six equally strong incised spiral lines. Aperture moderately large, oval; outer lip thin, showing the external sculpture within; columella slender, twisted and slightly revolute.

Professor Adams's type, which has served for our description and figure, is in the Amherst College collection and comes from Panama. It has nine post-nuclear whorls and measures: Length 5.4 mm., diameter 1.5 mm.

TURBONILLA (PYRGISCUS) MÖRCHI Dall and Bartsch.

Plate 7, figs. 6, 6*a*.

Turbonilla (*Pyrgiscus*) *mörchi* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 505, 506, pl. 45, figs. 1, 1*a*.

Shell broadly elongate-conic, the posterior third of the exposed portion of the whorls on the spire and a narrow area about the umbilical region flesh-colored, the rest of the shell light chestnut brown. Nuclear whorls two and one-half, small, smooth, forming a depressed helicoid spire which has its axis at right angles to the axis of the succeeding turns and is about one-fifth immersed in the first of them. Exposed portion of the post-nuclear whorls flattened in the middle, posterior fourth sloping gently toward the summit, which is closely appressed to the preceding turn; the anterior portion slopes more abruptly, roundly toward the periphery. The whorls are ornamented by strong rather distantly spaced, moderately acute, slightly protractive axial ribs, of which 18 occur upon the first three, 16 on the next three, 18 on the seventh, and 20 upon the penultimate turn. The ribs weaken slightly and become somewhat flattened as they approach the constricted sutures. Intercostal spaces broad, almost double the width of the ribs, crossed by 7, equal and equally spaced, deeply incised spiral lines, which extend up on the sides of the ribs and feebly across them. The space between the second and third lines appears slightly nodulose on the ribs. Periphery of the last turn angulated, crossed by the continuations of the ribs, which disappear as they pass on to the short and well-rounded base. Base marked by 13 continuous incised spiral lines of about equal strength which are much more closely spaced near the umbilicus than the periphery, the distance between the succeeding striations diminishing in regular ratio from the periphery to the umbilical area, the first two below the periphery being considerably more distantly spaced than the rest, the spaces inclosed between them being about equal to the space inclosed between the spiral lines on the spire. Aperture subquadrate, posterior angle acute, outer lip thin, showing the external sculpture within; columella slender, oblique, somewhat twisted and slightly revolute.

The type (Cat. no. 173081, U.S.N.M.) has nine post-nuclear whorls and measures: Length 6.4 mm., diameter 2 mm. It was collected by Mr. H. N. Lowe at Long Beach, California. Another specimen is in the collection of the University of California from station 122, near Redondo. Another (Cat. no. 176622, U.S.N.M.) was dredged by Mr. John Paine in 8 fathoms off Catalina Island. Five (Cat. no. 196230, U.S.N.M.) were collected by Mr. H. N. Lowe at San Diego, and four additional specimens from the same locality are in Mr. Lowe's collection. One, collected at station 83, off San Diego, is in the collection of the University of California.

This species is nearest related to *Turbonilla* (*Pyrgiscus*) *latifundia* Dall and Bartsch, from the post-Pliocene of San Pedro, California.

TURBONILLA (PYRGISCUS) ARAGONI, new species.

Plate 9, figs. 12, 12*a*.

Shell elongate-conic, anterior half of whorls chestnut brown, the rest, flesh colored. Nuclear whorls two, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is one-fifth immersed. Post-nuclear whorls well rounded, slightly contracted at the suture, appressed at the summit, marked by acute vertical axial ribs, of which 16 occur upon the first to seventh, 20 upon the eighth, and 26 upon the penultimate turn. Intercostal spaces about two and one-half times as wide as the ribs, marked by fine lines of growth and seven strongly incised spiral grooves, and numerous exceedingly fine, spiral striations. Sutures slightly contracted. Periphery of the last whorl slightly angulated, marked by a narrow plain band. Base short, well rounded, marked by fifteen well incised and numerous very fine spiral lines. Aperture rhomboidal, posterior angle obtuse; outer lip thin, showing the external markings within; columella slender, slightly curved.

The type (Cat. no. 206867, U.S.N.M.) was dredged by Mr. S. S. Berry, in 29 fathoms, on sandy bottom, off New Monterey, Monterey Bay. It has ten post-nuclear whorls and measures: Length 7.2 mm., diameter 2 mm.

TURBONILLA (PYRGISCUS) RECTA, new species.

Plate 7, figs. 12, 12*a*.

Shell broadly conic, milk-white. Nuclear whorls small, two and one-half, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-third immersed. Post-nuclear whorls slightly rounded, somewhat exserted, weakly shouldered at the summit, marked by slender, protractive axial ribs, of which 22 occur upon the second, 24 upon the third, 28 upon the fourth and fifth, and 30 upon the penultimate whorl. Intercostal spaces about as wide as the ribs, marked by eight equal and equally spaced spiral series of pits. Sutures strongly marked, crenulated by the ribs. Periphery of the last whorl well rounded, appearing as a broad plain band, marked only by the feeble continuations of the axial ribs. Base short, well rounded, marked by ten equal and almost equally spaced spiral striations. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, strongly curved, slightly revolute, with a weak fold at its insertion.

The type (Cat. no. 162635, U.S.N.M.) comes from Point Abreojos, Lower California. It has seven post-nuclear whorls and measures: Length 3.6 mm., diameter 1.3 mm. Another specimen (Cat. no. 162634, U.S.N.M.) comes from San Diego, California.

TURBONILLA (PYRGISCUS) WELDI, new species.

Plate 8, fig. 11.

Shell large, chestnut brown with a broad peripheral light band, and a light area about the columella. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, somewhat overhanging, strongly contracted at the suture, appressed at the summit, marked by moderately strong, rounded, slightly retractive axial ribs, of which 24 occur upon the third to fifth, 28 upon the sixth, and about 35 upon the penultimate turn, upon which they are less regular than on the others. Intercostal spaces a little wider than the ribs, marked by eight broad, deep spiral series of pits which are subequal, excepting the three above the peripheral one, the median one of which is much narrower than the rest. Sutures strongly constricted. Periphery and base of the last whorl inflated, well rounded, marked by the feeble continuations of the axial ribs, a broad line of pits immediately below the periphery, and seven equal and equally spaced, broad, well incised spiral lines. Aperture large, broadly oval, posterior angle acute; outer lip very strongly curved, thin, showing the external markings within; columella slender, twisted, curved and slightly revolute.

The type (Cat. no. 206868, U.S.N.M.) was dredged by the University of California at station 14, off Point Fermin, California. It has lost the nucleus and probably the first post-nuclear whorl. The eight remaining whorls measure: Length 8.8 mm., diameter 2.7 mm.

Named for Prof. Laenas G. Weld.

TURBONILLA (PYRGISCUS) NEREIA, new species.

Plate 8, figs. 1, *1a*.

Shell broadly conic, pale yellow, with a broad dark wax yellow band, which extends over a little more than one-half the distance from the middle of the whorls to the summit, between the sutures. A secondary of the same color extends from a little posterior to the periphery to the middle of the base. Nuclear whorls small, two and one-half, forming a depressed helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which they are very slightly immersed. Post-nuclear whorls flattened in the middle, slightly rounded at the summit and at the periphery, ornamented by well rounded, strong, almost vertical axial ribs, which become weakened toward the summit. These ribs are scarcely indicated on the first and second whorls, upon the third and fourth there are 20, upon the remaining (excepting the penultimate whorl which has 20) there are 18. Intercostal spaces about double as wide as the ribs, marked by nine spiral series of pits, all of which pass strongly upon the sides of the ribs, but do not cross their summits.

Of these pits the peripheral one and the three anterior to the one at the summit are stronger than the rest; the space separated by the second and third below the summit is a little wider than the rest, and the pits biting in the ribs render these somewhat nodulose at this place. Sutures well impressed. Periphery of the last whorl well rounded. Base moderately long, well rounded, marked by the continuations of the axial ribs which extend feebly to the umbilical region, and about eight weakly incised spiral lines, those nearest the periphery being somewhat interrupted by the ribs. Aperture suboval; posterior angle acute; outer lip thin, showing the external markings within; columella slender, slightly twisted and very oblique.

The type (Cat. no. 206869, U.S.N.M.) comes from San Diego. It has ten post-nuclear whorls and measures: Length 5.8 mm., diameter 1.7 mm. Cat. no. 163260, U.S.N.M., contains another specimen, collected by Mrs. Oldroyd at San Pedro, California.

TURBONILLA (PYRGISCUS) ANTESTRIATA Dall and Bartsch.

Plate 8, figs. 5, 5*a*.

Turbonilla (*Pyrgiscus*) *antestriata* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 506, 507, pl. 45, figs. 4, 4*a*.

Shell large and strong, light brown. Nuclear whorls two and one-half, small, smooth, forming a depressed rounded helicoid spire, which projects somewhat beyond the left side of the outline of the spire of the later whorls and has its axis at a right angle to the axis of these, being about one-fourth immersed in the first turn. Post-nuclear whorls slightly rounded, ornamented by low, rounded, narrow, vertical axial ribs which become decidedly flattened and enfeebled near the summit of the turns; there are 9 of these ribs on the second, 20 upon the fifth, and 28 upon the penultimate post-nuclear turns. Intercostal spaces about double the width of the ribs, shallow, rounded, crossed by 6 equal and equally spaced, strongly incised, spiral lines which extend stronger upon the sides of the ribs and feebly over their summits. In addition to this sculpture, the spire is marked by many fine lines of growth and many fine spiral striations between the incised lines. Sutures well marked, simple. Periphery of the last whorl subangulated, marked by the feeble continuations of the axial ribs, which disappear at the periphery. Base short, marked by 11 continuous, equal, strong, incised spiral lines which are more closely spaced above the umbilical area than at the periphery; the space between the first basal incised line and the first supraperipheral one being a little wider than the space inclosed between the spiral lines on the spire. Aperture subquadrate, outer lip thin, showing the external sculpture within; columella almost straight and vertical, slightly revolute.

The above description is based upon two cotypes. One, an adult shell (Cat. no. 168867, U.S.N.M.), has the last 10 whorls, having lost the nucleus and probably the first two and one-half post-nuclear turns, and measures: Length 9.7 mm., diameter 2.8 mm. It was dredged by the U. S. Bureau of Fisheries steamer *Albatross* at station 3194 in 92 fathoms, on gray sand, bottom temperature 45°.9, off Esteros Bay, California. The other (Cat. no. 196232, U.S.N.M.) was collected by Mrs. Oldroyd at San Pedro, California, and has the nucleus and 9 post-nuclear turns, and measures: Length 5.5 mm., diameter 1.8 mm. Three specimens (Cat. no. 196233, U.S.N.M.) were dredged by the Fisheries steamer *Albatross* at station 2902 in 53 fathoms, fine gray sand and mud bottom, temperature 45°, off Santa Rosa Island. One in the collection of the University of California comes from station 122, near Redondo; another in the same institution was dredged at station 12, off Point Vincent. Two (Cat. no. 196231, U.S.N.M.) were dredged in 12 fathoms at San Pedro by Mr. H. N. Lowe. Another specimen was dredged by the University of California at station 30, off Catalina Island, and two at station 58, off San Diego, California, the last two lots being in the University collection.

TURBONILLA (PYRGISCUS) ANTEMUNDA, new species.

Plate 8, figs. 15, 15*a*.

Shell broadly conic, milk-white with a moderately broad pale yellow band at the periphery and another at the middle of the whorls between the sutures of the same width. Nuclear whorls two and three-fourths, helicoid, having its axis at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls moderately rounded, appressed at the summit, strongly contracted at the periphery, somewhat overhanging, ornamented by well-developed, narrow axial ribs, which become decidedly enfeebled toward the summit. Of these there are 16 upon the first to fourth, 18 upon the fifth to seventh, 20 upon the eighth, 22 upon the ninth and penultimate whorl. Intercostal spaces about two and one-half times as wide as the ribs, ornamented with a double series of spiral markings, the first of which consists of seven strongly incised and subequally spaced pits between the sutures, the third and fourth of which above the periphery bound the color band and are a little closer spaced than the rest. The first one below the summit passes over the axial ribs and gives them a truncated appearance; the others pass up on the sides of the ribs but do not cross them. The second series of spiral markings consist of very fine lines, of which three occur between the peripheral series of pits and the second two occur between the second and third, one between the fourth and fifth, two between the sixth and seventh. In addition to this sculpture there are many microscopic lines of growth and microscopic spiral striations. Sutures well marked. Periphery of the last whorl somewhat angulated, marked by the feeble extensions of the axial ribs. Base short, well rounded, smooth, excepting the fine lines of growth and exceedingly fine, weakly incised spiral striations, among which about nine equal and equally spaced are a trifle stronger than the rest. Aperture rhomboid; outer lip thin, showing the external sculpture within; columella moderately strong and slightly revolute.

The above description is based on two cotypes (Cat. no. 168866, U.S.N.M.). This has furnished the description of the adult shell. It has lost the nucleus and first post-nuclear whorl. The ten remaining measure: Length 6.9 mm., diameter 2.2 mm. The other is a young individual and has served for the description of the nucleus and first post-nuclear whorl. These were dredged at U. S. Bureau of Fisheries, station 2901, off Santa Rosa Island, California.

The following specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	U.S.B.F. station.	Locality.	Depth, fathoms.	Temp. degrees.	Disposition of material.
168866	2	2901	Santa Rosa Island, California.	48	55.1	U. S. Nat. Mus.
206872	20	2902	.....do.....................	53	45	Do.
	1		Off Catalina Island, California, sta. 32.	....	....	Univ. Cal.

TURBONILLA (PYRGISCUS) FLAVESCENS Carpenter.

Plate 8, fig. 9.

Chemnitzia flavescens CARPENTER, Cat. Maz. Shells, 1856, p. 432.

Shell slender, yellowish. Nuclear whorls two and one-half, forming a helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls at first well rounded, later flattened, marked by slender, somewhat curved, almost vertical axial ribs, of which 18 occur upon the first, 20 upon the second, 22 upon the third and remaining whorls. Intercostal spaces about twice as wide as the ribs, marked by numerous fine, closely spaced spiral striations. Periphery and base of the last whorl well rounded, marked by the feeble continuations of the axial ribs, and many fine spiral striations. Aperture oval; posterior angle acute; outer lip thin; columella slender, strongly curved.

The single specimen of this shell known is on tablet 2003, Havre collection, British Museum, and was taken from a specimen of *Spondylus calcifer* at Mazatlan, Mexico. It has six post-nuclear whorls, the aperture being badly broken, and measures: Length 2.75 mm., diameter 0.8 mm.

TURBONILLA (PYRGISCUS) MACBRIDEI, new species.

Plate 8, figs. 13, 13*a*.

Shell exceedingly slender, light yellow, with a broader darker yellow band immediately below the summit and another halfway between this and the suture. Nuclear whorls large, one and three-fourths, forming a depressed helicoid spire, the axis of which is at right angles to that of the succeeding turns, on the first of which it rests, but is not immersed. Post-nuclear whorls exceedingly high between the sutures, moderately rounded, marked by slender, very regular, slightly curved, well rounded, somewhat retractive axial ribs, of which 24 occur upon the first, 22 upon the second and third, 24 upon the fourth and fifth, 26 upon the sixth and seventh, and about 32 upon the penultimate whorl. Intercostal spaces about as wide as the ribs, well impressed, marked by fifteen equal and equally spaced spiral series of pits, which owing to the narrowness of the intercostal spaces, appear as mere punctations. Sutures well marked. Periphery of the last whorl without spiral sculpture. Base moderately long, marked by the continuations of the axial ribs, and six equal and equally spaced spiral striations on its anterior two-thirds. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, decidedly flexuose, and very slightly revolute.

The type (Cat. no. 191563 U.S.N.M.) of this exceedingly slender shell comes from U. S. Bureau of Fisheries, station 2826, in 9½ fathoms, off La Paz, Lower California. It has nine post-nuclear whorls, and measures: Length 4 mm., diameter 0.8 mm.

Named for Prof. Thomas H. Macbride.

TURBONILLA (PYRGISCUS) NUTTALLI, new species.

Plate 8, fig. 2.

Shell large, elongate-conic, yellowish-white, with a light-brown area about the columella. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, slightly shouldered at the summit, scarcely at all contracted at the periphery; marked by strong, narrow, well rounded, slightly protractive axial ribs, of which 14 occur upon the third, 16 upon the fourth to eighth, and 18 upon the remaining turns. Intercostal spaces about one and one-half times as wide as the ribs, shallow, marked by about 30 incised spiral lines which are strongest at the periphery and gradually weaken toward the summit. A moderately broad, plain area on the middle between the sutures is left unmarked. Periphery and base of the last whorl well rounded, marked by the feeble continuations of the axial ribs and numerous exceedingly fine, closely spaced, wavy, spiral striations. Aperture small, rhomboidal; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella strong, straight, and revolute.

The type (Cat. no. 56791, U.S.N.M.) is labeled "South America," without specific designation of locality. It has lost the nucleus and probably the first post-nuclear turn. The thirteen remaining measure: Length 9.9 mm., diameter 2.1 mm.

Named for Thomas Nuttall.

TURBONILLA (PYRGISCUS) MACRA, new species.

Plate 8, figs. 10, 10*a*.

Shell very small, subcylindric in the middle, tapering rapidly at the apex, early whorls wax-yellow, later ones white, with a very broad, wax-yellow band at the periphery, which extends above the sutures and on the base. Nuclear whorls very small, at least two, forming a depressed helicoid spire, which is obliquely half immersed in the first of the succeeding turns. Post-nuclear whorls moderately rounded at first, later flattened, ornamented by almost straight, vertical, slender, well-developed axial ribs, of which there are 22 upon the first, 24 upon the second to fifth, and 25 upon the penultimate turn. Intercostal spaces about as wide as the ribs, marked by five equal but not equally spaced series of spiral pits. The first four of these above the periphery are equally spaced; the fifth is a little nearer to the summit of the whorl than its neighbor. Sutures well impressed. Periphery of the last whorl well rounded, marked by the feeble continuations of the axial ribs. Base of the last whorl prolonged, well rounded, marked by six equally spaced and equally strongly incised spiral lines. Aperture ovate; posterior angle acute; outer lip thin, showing the external markings within; columella moderately strong, reënforced by the base, provided with a weak fold at its insertion; parietal wall covered with a thin callus.

The type (Cat. no. 162632, U.S.N.M.) and five other specimens were obtained at Point Abreojos, Lower California. The type has seven post-nuclear whorls, and measures: Length 3.2 mm., diameter 0.9 mm.

TURBONILLA (PYRGISCUS) ANGUSTA Carpenter.

Plate 8, fig. 6.

Chrysallida angusta CARPENTER, Ann. Mag. Nat. Hist., (3d ser.,) vol. 14, 1864, p. 47.

Shell elongate-conic, slender, crystalline. (Nuclear whorls decollated.) Post-nuclear whorls slightly rounded, moderately contracted at the sutures, slightly shouldered at the summit, marked by low, rounded, axial ribs, of which 16 occur upon all but the penultimate whorl, upon which there are 18. Intercostal spaces about one and one-half times as wide as the ribs, marked by 6 equal and equally spaced spiral lirations between the sutures. Base somewhat produced, moderately rounded, marked by the feeble continuations of the axial ribs and nine spiral lirations which become successively weaker from the periphery to the umbilical area. Aperture oval;

posterior angle acute; outer lip thin, showing the external sculpture within; columella stout, somewhat reflected.

The type (Cat. no. 16212, U.S.N.M.,) was collected by Xantus at Cape St. Lucas, Lower California. It has 6 post-nuclear whorls, and measures: Length 2.3 mm., diameter 0.8 mm.

TURBONILLA (PYRGISCUS) TENUICULA Gould.

Plate 8, figs. 3, 7, 7*a*, 12, 12*a*, 14, 14*a*.

Chemnitzia tenuicula GOULD, Bost. Journ. Nat. Hist., vol. 6, 1853, pp. 383–384, pl. 14, fig. 15.=*Chemnitzia terebralis* CARPENTER, Cat. Mazatlan Shells, 1856, p. 432.=*Chemnitzia unifasciata* CARPENTER, Cat. Mazatlan Shells, 1856, p. 433. =*Chemnitzia* ? var. *subcuspidata* CARPENTER, Rept. Brit. Assn. Adv. Sci., 1863, p. 659.=*Chemnitzia crebrifilata* CARPENTER, Rept. Brit. Assn. Adv. Sci., 1863, p. 659.=*Turbonilla* (*Pyrgiscus*) *crebrifilata* (CARPENTER) DALL and BARTSCH, Mem. Cal. Acad. Sci., vol. 3, 1903, p. 276, pl. 2, figs. 6, 6*a*.=*Turbonilla* (*Pyrgiscus*) *subcuspidata* (CARPENTER) DALL and BARTSCH, Mem. Cal. Acad. Sci., vol. 3, pp. 276–277, pl. 2, figs. 2, 2*a*.

"Shell small, elongated, lanceolate, turrited, rather solid, shining, wax yellow, a little dusky below the suture; whorls 10, flat, slightly shouldered above, marked by about 20 direct, longitudinal folds, the summits of which are cut by numerous fine revolving striæ, deeper in the interstices, which also extend over the base of the shell, though the folds terminate at the periphery, or are extended in delicate furrows; aperture narrow, ovate; lip sharp; revolving striæ apparent within.

Dimensions.—Length 7.5 mm.; diameter 1.3 mm.

Found at Santa Barbara."

The above is the original description by Gould. *Turbonilla* (*Pyrgiscus*) *tenuicula* Gould is the most abundant and most variable species of all the west American forms, presenting many varieties or incipient species; to describe these would not aid science or the collector, but would only add to the confusion which this paper is intended to dispel. The following comprehensive description will embrace, we believe, all the forms coming under this name:

Shell slender to somewhat stubby and inflated, varying in color from milk-white to waxy yellow or to dark brown, variously banded or plain monocolored; nuclear whorls three, moderately large, planorboid, slightly slantingly immersed; post-nuclear whorls rounded to flattened, contracted at base and strongly shouldered at the summit, traversed by 18 to 28 strong vertical ribs, which are excurved and usually somewhat thickened, and connected at their summits, which appear beaded; these ribs extend feebly over the rounded base of the last whorl; the entire shell is crossed by incised spiral lines, 10 to 16 or more of which appear on the exposed portion of the whorls, and more, closer placed, wavy ones on the base of the last whorl; the suture is deep, subchanneled and wavy; aperture ovate, produced at base; outer lip thin, meeting the oblique, slightly curved and revolute columella in a broad curve; a faint callus connects the posterior angle of the aperture with the insertion of the columella.

The specimen figured is from Todos Santos Bay, Lower California, has 9 post-nuclear whorls and measures: Length 6.5 mm., diameter 1.9 mm. Figures 12 and 12*a* represent the forms described by Carpenter as *crebrifilata* and figures 14 and 14*a* that named *subcuspidata* by the same author. Figure 3 shows an extreme variant.

We have examined the following specimens:

U.S.N.M. cat. no.	No. of specimen.	Locality.	Collector.	Disposition of material.
32245	2	Monterey, California	Carpenter	U. S. Nat. Mus.
16267a	[a] 1	Santa Barbara, California	Col. Jewett	Do.
162637	1	Santa Barbara Islands, California		Do.
	6	Arch Beach, California		Univ. Cal.
151724	2	San Pedro, California	E. W. Roper	U. S. Nat. Mus.
152198	2	do	Mrs. Johnston	Do.
191547	7	do	F. L. Button	Do.
160480	1	do		Do.
196227	1	do	Mrs. Oldroyd	Do.
	428	do	do	Oldroyd coll.
196226	25	San Pedro (White's Point), California	do	U. S. Nat. Mus.
	1	do	do	Oldroyd coll.
206873	1	Off Catalina Island, California		U. S. Nat. Mus.
	1			Univ. Cal. coll.
	1	Pacific Beach, San Diego, California		Oldroyd coll.
192228	1	do	H. Hemphill	U. S. Nat. Mus.
122318	2	Ocean Beach, San Diego, California	F. W. Kelsey	Do.
153065	7	do	do	Do.
46504	3	San Diego, California	R. E. C. Stearns	Do.
	2	do	Delos Arnold	Univ. Cal. coll
	4	do		Do.
14829	[b] 1	do	J. G. Cooper	U. S. Nat. Mus.
	3	do	H. Hemphill	
60933	2	do	C. R. Orcutt	Do.
160481	5	do		Do.
206874	1	U. S. Bureau Fisheries station 3566 off San Diego, California. Three fathoms.		Do.
206875	1	San Diego, California		Do.
157204a	1	do		Do.
105585	1	Point Abreojos, Lower California	H. Hemphill	Do.
106510	2	do	do	Do.
32284	[c] 7	Todos Santos Bay, California	R. E. C. Stearns	Do.

[a] Figured.
[b] Figured type of *Turbonilla tenuicula subcuspidata.*
[c] Figured *crebrifilata.*

TURBONILLA (PYRGISCUS) VIRGO Carpenter.

Plate 8, figs. 4, 4*a*.

Chemnitzia virgo CARPENTER, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 396.

Shell elongate-conic, milk-white. Nuclear whorls small, two, forming a depressed helicoid spire, the axis of which is almost at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls moderately rounded, slightly shouldered at the summit, weakly contracted at the periphery, ornamented by slender, sinuous protractive axial ribs, of which 24 occur upon the first and second, 22 upon the third, 20 upon the fourth to sixth, 22 upon the seventh and penultimate turn. Intercostal spaces about one and one-half times as wide as the ribs, well impressed, marked by six strongly impressed series of pits which extend up on the sides of the ribs but do not cross them; the peripheral and the third posterior to this are of equal strength and stronger than the rest. The space between the third and fourth above the perihery is a little wider than that between the others, which are about equally spaced. The space between the summit and the first spiral line below it is about equal to about double the space included between the other spirals. A finely incised line divides it into equal areas. Sutures strongly impressed, rendered wavy by the ribs. Periphery well rounded, marked by the feeble continuations of the axial ribs and a few distantly spaced spiral striations. Aperture oval; posterior angle obtuse; outer lip thin, columella moderately strong, sinuous and slightly reflected.

The type (Cat. no. 73993 U.S.N.M.) was collected by Dr. R. E. C. Stearns at Santa Barbara, California. It has nine post-nuclear whorls and measures: Length 4.8 mm., diameter 1.3 mm.

TURBONILLA (PYRGISCUS) MARSHALLI, new species.

Plate 8, figs. 8, 8*a*.

Shell very small, slender, light yellow, with a darker band immediately posterior to the periphery, and another slender one about halfway between the middle of the space between the sutures and the summit. Nuclear whorls depressed, helicoid, two and one-half, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fifth immersed. Post-nuclear whorls high between the sutures, flattened in the middle, gently rounded at the periphery and the summit, marked by slender, retractive axial ribs, of which 22 occur upon the first and second, 24 upon the third to fifth, 26 upon the sixth, and 24 upon the penultimate turn. Intercostal spaces a little wider than the ribs, moderately well impressed, marked by seven strong subequal series of pits between the periphery and the subsutural color band, and three fine incised lines posterior to this. Periphery of last whorl well rounded. Base moderately long, marked by the feeble continuations of the axial ribs and five subequal, equally spaced spiral striations. Aperture ovoid; posterior angle acute; outer lip thin, showing the external sculpture within; columella very oblique, curved, twisted, and slightly revolute.

The type and another specimen (Cat. no. 163262, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2822, in 21 fathoms, off La Paz, Lower California. The type has eight post-nuclear whorls and measures: Length 3.6 mm., diameter 0.8 mm.

TURBONILLA (PYRGISCUS) CANFIELDI Dall and Bartsch.

Plate 9, figs. 3, 3*a*.

Turbonilla (*Pyrgiscus*) *canfieldi* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 504, 505, pl. 47, figs. 4, 4*a*.

Shell slender, elongate-conic, with the posterior half of the exposed portion of the whorls on the spire white and the anterior half chestnut brown, base white. Nuclear whorls two and two-thirds, large, smooth, forming a depressed helicoid spire whose axis is at right angles to the axis of the succeeding turn; not immersed and extending slightly beyond the outline of the spire on both sides. Post-nuclear whorls very slightly rounded, weakly roundly shouldered at the summit and very moderately contracted at the periphery, ornamented by very strong, broad, low, rounded, almost vertical axial ribs of which there are 22 upon the first, 24 upon the antepenultimate, and 28 upon the penultimate turn. These ribs extend prominently to the summit and crenulate the subchanneled sutures. Intercostal spaces narrow, not more than half the width of the ribs, crossed by 19 incised spiral lines which are of almost equal width and subequally spaced with the following exceptions, the seventh, eleventh, and the last three above the periphery are much wider, appearing as quadrangular pits in the intercostal spaces, the eleventh falling on about the middle of the exposed portion of the whorl on the spire, and the seventh about halfway between this and the summit. Periphery and base of the last whorl well rounded, the latter marked by the feeble continuations of the axial ribs which gradually disappear after crossing the periphery, and about 16 subequally spaced incised spiral lines. Aperture oval, somewhat effuse anteriorly, columella oblique, somewhat twisted, with a weak oblique fold a little anterior to its insertion.

The type (Cat. no. 196229, U.S.N.M.) was dredged by Mr. S. S. Berry in 12 fathoms off Del Monte, Monterey, California. It has 10 post-nuclear whorls and measures: Length 6.3 mm., diameter 1.2 mm.

TURBONILLA (PYRGISCUS) ALMO, new species.

Plate 9, figs. 8, 8*a*.

Shell slender, light brown, wax-yellow at tip. Nuclear whorls very small, two and one-half, planorboid, having their axis at right angles to that of the succeeding turns, in the first of which they are slightly immersed. First post-nuclear whorl almost smooth, the second with a mere indication of ribs, well rounded. The remaining post-nuclear whorls somewhat overhanging, appressed at the summit, well rounded, marked by moderately developed, rounded, retractive axial ribs, of which about 20 occur upon all but the penultimate whorl; upon this there are 22. Intercostal spaces a little wider than the ribs, marked by seven deep pits of unequal width and unequal spacing. Periphery of the last whorl marked by a broad plain band. Base well rounded, marked by the very feeble continuations of the axial ribs and nine irregular, wavy, incised spiral lines, the first two of which below the periphery are interrupted. Aperture ovate; posterior angle acute; outer lip thin, showing the external markings within; columella slender, very oblique, somewhat flexuose and revolute, with a slight fold at its insertion.

The type and three specimens (Cat. no. 162633, U.S.N.M.) were dredged in 2 fathoms off San Diego, California. The type has eight post-nuclear whorls and measures: Length 4.6 mm., diameter 1.2 mm.

TURBONILLA (PYRGISCUS) CALLIPEPLUM, new species.

Plate 9, figs. 11, 11*a*.

Shell elongate-conic, rather stout, milk-white. Nuclear whorls two, forming a planorboid spire, whose axis is at right angles to the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls flattened in the middle, with a strongly sloping shoulder which extends over the posterior fourth between the sutures, forming a decided angle at its anterior termination; slightly contracted at the suture, marked by slender, sinuous, slightly retractive, sublamellar, axial ribs, of which 14 occur upon the first two whorls, 16 upon the third and fourth, 18 upon the fifth, and 20 upon the remaining turns. Intercostal spaces varying somewhat in width, about four times as wide as the ribs, marked by a double series of narrow pits, one of which is at the periphery and the other at the anterior termination of the posterior third of the whorls. In addition to these pits there are finely incised lines of varying strength, 18 of which occur between the two pits and 9 between the posterior pit and the summit. Sutures well impressed. Periphery of the last whorl slightly angulated. Base marked by the feeble continuations of the axial ribs, which extend a little ways beyond the periphery, and 17 almost equal and almost equally spaced, slender, incised spiral lines. Aperture? (outer lip fractured); columella reflected.

The type (Cat. no. 122797, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2805 in 51 fathoms, on mud bottom, in Panama Bay. It has nine post-nuclear whorls and measures: Length 5.1 mm., diameter 1.4 mm.

TURBONILLA (PYRGISCUS) DINA, new species.

Plate 9, fig. 10.

Shell elongate-conic, milk-white. Nuclear whorls two and one-half, forming a depressed, helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is about one-fifth immersed. Post-nuclear whorls slightly rounded on the anterior two-thirds between the sutures, posterior third forming a strong sloping shoulder, marked by narrow, lamellar ribs, of which 18 occur upon the first, 16 upon the second to seventh, and 18 upon the eighth and penultimate turn. Intercostal spaces about four times as wide as the ribs, marked by a double series of pits, one of which is at the periphery and the other at the angle of the shoulder. The space between the two pits is crossed by nine equal and equally spaced spiral striations, the space between the summit and the submedian pit is marked by twelve incised spiral lines of which those near the summit are finer and closer spaced than the rest. Sutures strongly impressed. Periphery of the last whorl slightly angulated. Base short, well rounded, marked by about twenty equal and almost equally spaced spiral striations. Aperture rhomboidal; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, almost straight and somewhat revolute.

The type and another specimen (Cat. no. 162428, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2799, in Panama Bay, in 29½ fathoms. It has nine post-nuclear whorls and measures: Length 5.2 mm., diameter 1.5 mm.

TURBONILLA (PYRGISCUS) SHIMEKI, new species.

Plate 9, figs. 4, *4a*.

Shell elongate-conic, with a very large nucleus which extends beyond the outline of its post-nuclear spire; bluish-white with four rather broad, pale yellow bands, one of which is immediately below the summit and another at the periphery, a third halfway between the two, while the fourth is on the middle of the base. Nuclear whorls one and one-half, planorboid, having their axis at right angles to that of the succeeding turns, upon the first of which it rests. Post-nuclear whorls somewhat overhanging, appressed and slightly exserted at the summit, well rounded, the greatest convexity falling on the anterior third between the sutures, marked by broad, low, rounded, slightly retractive axial ribs on all but the first two whorls, which are smooth. Of these ribs, 14 occur upon the third to sixth, 16 upon all the remaining whorls excepting the penultimate, which has 18. Intercostal spaces shallow, almost twice as wide as the ribs, marked by nineteen series of incised spiral pits, of which the peripheral and the sixth below the summit are a little stronger than the rest. Sutures well impressed. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs and spiral lines like those between the sutures. Aperture moderately large, oval; posterior angle acute; outer lip thin, showing the external markings within; columella slender, flexuose, and slightly revolute.

The type and one other specimen (Cat. no. 206877, U.S.N.M.) were dredged by the U. S. Bureau of Fisheries at station 2813, in 40 fathoms, on coral sand bottom, off the Galapagos Islands, South America. It has ten post-nuclear whorls and measures: Length 5.6 mm., diameter 1.2 mm.

Named for Prof. B. Shimek.

TURBONILLA (PYRGISCUS) SANCTORUM, new species.

Plate 9, figs. 2, 2*a*.

Shell elongate-conic, milk-white. Nuclear whorls two and one-fourth, forming a depressed, helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls very strongly rounded, appressed at the summits, contracted at the periphery, marked by strong sublamellar, slightly protractive axial ribs, of which 16 occur upon the first to eighth, 18 upon the ninth, and 20 upon the penultimate turn. Intercostal spaces about four times as wide as the ribs, marked by two series of broad spiral pits, one of which is at the periphery, the other a little posterior to the middle of the space between the sutures. In addition to these pits there are fine, almost equal, incised spiral lines, of which eight occur between the peripheral and median pits and ten between the median and the summit. Sutures strongly constricted. Periphery marked by a narrow plain band. Base well rounded, marked by the feeble continuations of the axial ribs and fourteen equal, fine wavy, incised spiral lines. Aperture subquadrate; posterior angle obtuse; outer lip thin, showing the external markings within; columella very oblique, almost straight, reflected.

The type and twenty specimens (Cat. no. 162514, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2823, off La Paz, in 26½ fathoms, off Lower California. The type has ten post-nuclear whorls and measures: Length 5.8 mm., diameter 1.3 mm. Cat. no. 162516, U.S.N.M., contains four specimens dredged at U. S. Bureau of Fisheries station 2827, off Ceralvo Island, Gulf of California, in 10 fathoms, off Lower California.

TURBONILLA (PYRGISCUS) EUCOSMOBASIS Dall and Bartsch.

Plate 10, figs. 11, 11*a*.

Turbonilla (*Pyrgiscus*) *eucosmobasis* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 507–508, pl. 45, figs. 8, 8*a*.

Shell quite large, of very regular outline, creamy white. Nucleus rather small, composed of two and one-half whorls, helicoid with much depressed spire, somewhat obliquely about one-third immersed in the first of the succeeding turns, the axis of the nuclear spire being almost at a right angle to the axis of the later whorls. Post-nuclear whorls moderately rounded, widest a little above the suture, sloping gently toward the summit and more abruptly toward the base, ornamented by moderately strong, rounded, somewhat flexuous, axial ribs, of which about 18 appear upon the second, 20 upon the seventh, 22 upon the eighth, and 27 upon the penultimate whorl. Intercostal spaces only moderately deep, a little wider than the ribs, marked by 6 strong incised spiral lines which extend up on the sides of the ribs and frequently pass over their summits; the uppermost or posterior one of these incised lines is least pronounced, the second one above the suture, and the third one about half again as far apart as the remaining, which are equally spaced. In addition to these the shell is marked by many faint wavy spiral striations between the deep ones. Sutures plain, well defined. Base of the last whorl very short, well rounded, marked by the faint continuations of the axial ribs and about 15 well defined more or less equally spaced deep spiral striations with fainter ones between them as on the exposed portion of the whorls of the spire; the first deep basal spiral striation and the one above the suture are some little distance apart and mark a plain band excepting the fainter sculpture. Aperture quite large, subquadrate; columella short, somewhat twisted, revolute.

The type (Cat. no. 162679, U.S.N.M.) was dredged by the U. S. Bureau of Fisheries steamer *Albatross* at station 2902, off Santa Barbara, California, in 53 fathoms. It has 12 post-nuclear whorls which measure: Length 11.2 mm., diameter 2.8 mm.

Another specimen (Cat. no. 162680, U.S.N.M.) was dredged at station 3195, in 252 fathoms, on green mud, bottom temperature 43°.2, in San Luis Obispo Bay, California. Four specimens (Cat. no. 162681)were dredged at station 2901, on gray sand and mud bottom, at a depth of 48 fathoms, temperature 55°.1, off Santa Rosa Island. The University of California has two lots, one specimen dredged at station 32, off Catalina Island, and two from station 59, off San Diego, California.

TURBONILLA (PYRGISCUS) HALIDOMA, new species.

Plate 9, figs. 6, 6*a*.

Shell elongate-conic, milk-white. Nuclear whorls small, two and one-fourth, forming a moderately elevated spire whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls flattened in the middle, with a sloping shoulder that extends over the posterior fourth between the sutures and renders the whorls slightly angulated at their anterior margin; weakly contracted at the suture, marked by moderately strong, well rounded, low, retractive axial ribs, of which 24 occur upon the first, 26 upon the second and third, and 24 upon the remaining turns. Intercostal spaces a little more than double the width of the ribs, marked by pits and incised spiral lines. Of these the one at the periphery and the one at the anterior termination of the posterior third between the sutures are of equal width, and much wider than the rest; two other pits a little less strong divide the space between the two strong pits into three segments, the middle one of which is a trifle wider than the other two which are equal. The three areas are again divided by finer lines, the first above the periphery being crossed by one, the next by three and the third by two fine striations. The space between the summit and the deep series of pits anterior to it is crossed by four incised and wavy, exceedingly fine spiral lines. Periphery of the last whorl well rounded, marked by the feeble extensions of the axial ribs which disappear shortly after crossing it. Base well rounded, marked by twenty-two well incised subequal and subequally spaced spiral lines. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, twisted and slightly revolute.

The type (Cat. no. 162693, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2822 in 21 fathoms, off La Paz, Lower California. It has nine post-nuclear whorls and measures: Length 6.7 mm., diameter 1.8 mm.

TURBONILLA (PYRGISCUS) AURICOMA Dall and Bartsch.

Plate 9, figs. 5, 5*a*.

Turbonilla (*Pyrgiscus*) *auricoma* Dall and Bartsch, Mem. Cal. Acad. Sci., vol. 3, 1903, pp. 274, 275, pl. 1, figs. 4, 4*a*.

Shell slender, attenuated, brown, lighter on the early whorls, becoming dark on the last. Nuclear whorls two and one-half, large, helicoid, not immersed, projecting somewhat beyond the outline of the spire, their axis being at a right angle to the axis of the later whorls; post-nuclear whorls at first somewhat rounded, later flattened, marked by well-developed, rather strong, retractive axial ribs, of which 16 appear upon the third and fourth, 18 upon the fifth to eighth, 20 upon the ninth, 22 upon the tenth, and 30 upon the penultimate turn. Intercostal spaces a little wider than the ribs on all but the penultimate whorl; on this they are somewhat narrower, crossed between the sutures by nine subequally spaced, almost equally strong, spiral lines of pits, which pass up on the sides of the ribs but do not cross their summit. Periphery and base of last whorl inflated, well rounded, marked by the continuations of the axial ribs, which extend almost undiminished to the umbilical area and eight equally strong and almost equally spaced, well-incised spiral lines. Aperture ovate; posterior angle acute; outer lip thin, showing the external sculpture within, the spiral markings appearing as red threads; columella slender, rounded, reflected, the reflection giving the base an umbilicated appearance; the parietal wall covered by a strong callus.

The type and three specimens (Cat. no. 106511, U.S.N.M.) were collected at Scammon Lagoon, Lower California. The type has 12 post-nuclear whorls and measures: Length 7.2 mm., diameter 1.9 mm. Cat. no. 73997, U.S.N.M., contains a specimen from San Diego. Three have been determined for Mrs. Oldroyd from San Pedro and two for Doctor Arnold from Scammon Lagoon.

TURBONILLA (PYRGISCUS) CASTANEA Keep.

Plate 9, figs. 1, 1*a*.

Chemnitzia castanea (Carpenter,) Keep, West Coast Shells, 1888, p. 52, fig. 33.

Shell elongate-conic, chestnut brown. Nuclear whorls very small, two and one-half, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are about one-fourth immersed. Post-nuclear whorls flattened in the middle, slightly excurved at the summit, where they are faintly shouldered and somewhat contracted at the periphery, marked by rather irregular, strong, low, rounded, retractive axial ribs; of which 20 occur on the third, 22 on the fourth, 24 on the fifth to seventh, 26 on the eighth, 28 on the ninth, and about 50 upon the penultimate whorl; upon this they are very irregular. Intercostal spaces less wide than the ribs, shallow, marked by a series of spiral pits, which vary in width and number on the various whorls; on the early ones there are eight, on the ninth there are twelve, while on the penultimate there are sixteen between the peripheral series and the summit. Sutures well marked. Periphery and base of last whorl inflated, marked by the continuations of the axial ribs, which extend almost undiminished to the umbilical area; and about twenty subequal and subequally spaced incised spiral lines. Aperture pear-shaped; posterior angle acute; outer lip thin, showing the external sculpture within; chestnut brown; columella slender, strongly curved, and slightly revolute; parietal wall covered by a thick callus.

The specimen described and figured (Cat. no. 160224, U.S.N.M.) was collected by Mrs. Oldroyd at San Pedro, California. It has eleven post-nuclear whorls and measures: Length 10.5 mm., diameter 2.5 mm. Professor Keep's types which we have had for examination came from San Diego.

The following specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	U. S. B. F. station.	Locality.	Depth, fathoms.	Disposition of material.
160224	1	....	San Pedro, California	....	U. S. Nat. Mus.
162682	1	3566	San Diego, California	3	Do.
163264	1	3573	.....do	1.5	Do.
	2	....	.....do	....	D. Arnold coll.

TURBONILLA (PYRGISCUS) CASTANELLA Dall.

Plate 9, fig. 7.

Turbonilla (*Pyrgiscus*) *castanella* Dall, Nautilus, vol. 22, 1908, p. 131.=*Turbonilla* (*Pyrgiscus*) *castanea* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 509, 510, pl. 47, fig. 7; not *Chemnitzia castanea* Keep, West Coast shells, 1888, p. 5, fig. 33.

Shell very large, stout and heavy, chestnut brown. Nuclear whorls decollated. Post-nuclear whorls well rounded, ornamented by many broad, flattened, more or less regular and evenly placed retractive axial ribs, of which about 22 appear upon the third, 26 upon the fifth, and 40 upon the seventh whorl. On the penultimate and antepenultimate whorls they are more or less irregular in form, number, and spacing. Intercostal spaces much narrower than the ribs. The spiral sculpture consists of eight deep, quite regularly spaced lines of pits, which are very pronounced in the intercostal spaces and on the sides of the ribs, but do not appear to cross their summits except on the penultimate and the last whorl. Sutures well defined, simple. Periphery and base of the last whorl evenly rounded, the latter ornamented by the prolongation of the axial ribs and quite a number of continuous well-impressed spiral lines with faint spiral striation between them. Aperture suboval, somewhat effuse anteriorly, posterior angle obtuse (outer lip fractured, very thick); columella strong, slightly curved, and strongly revolute, with a weak, very oblique internal fold near its insertion; parietal wall and umbilical region covered by a weak callus. Columella and extreme anterior portion of the aperture white.

The type (Cat. no. 74000, U.S.N.M.) belongs to the Stearns collection and was obtained at Monterey, California. It has 10 post-nuclear whorls (the nucleus and perhaps the first three being lost), and measures: Length 13.5 mm., diameter 3.7 mm.

This species is remarkable for being the largest known member of the section *Pyrgiscus* on the west coast of America.

TURBONILLA (PYRGISCUS) INDENTATA Carpenter.

Plate 10, fig. 10.

Chrysallida indentata Carpenter, Cat. Mazatlan Shells, 1856, p. 425–426.

Shell elongate-conic, wax yellow. Nuclear whorls two, forming a subglobose, helicoid spire, whose axis is almost at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls moderately rounded, slightly contracted at the sutures, subtabulatedly shouldered at the summit, marked by strong, slightly protractive, axial ribs, of which 14 occur upon the first, 16 upon the second, 18 upon the third and fourth, 20 upon the fifth and sixth, and 22 upon the penultimate turn. Intercostal spaces as wide as the ribs, crossed by subequal, irregularly spaced, raised threads, the posterior one of which forms quite a cord at the summit of the whorls; this is followed by a rather wide pit; then two closely spaced, raised threads; another pit equal to the first; then six very fine closely spaced threads; a third pit equal to the others; two strong threads, followed by a peripheral pit. Periphery of the last whorl well rounded. Base rather prolonged, well rounded, marked by the continuation of the axial ribs, which extend to the umbilical area and eight spiral threads. Aperture oval; posterior angle acute; outer lip thin; columella slightly curved; parietal wall covered by a faint callus.

Two specimens were obtained off *Spondylus*, at Mazatlan, Mexico, one a young individual, the other an adult; the latter is on tablet 1986, Liverpool collection, British Museum. It has eight post-nuclear whorls, and measures: Length 3.8 mm., diameter 1.2 mm.

TURBONILLA (PYRGISCUS) CORA D'Orbigny.

Chemnitzia cora D'Orbigny, Voy. Am. Mérid., vol. 5, 1847, p. 398, pl. 76, figs. 7-9.

"Shell elongate-conic, thick, ornamented longitudinally by very deep folds, between which are fine, regular spiral striations, among which four are deeper, three of which reproduce themselves in very regular manner on all the whorls. Nucleus very large, oblong; spire elongate-conic, composed of eight flattened whorls which are separated by a very marked suture; aperture oval; lip thin; color white. Long. 5 mm., diam. 1.5 mm."

To the above diagnosis he adds: "Ornamented with ribs and transverse striæ, like *C. ornata*, this is larger in proportion, and is remarkable in that four of the striæ are more profoundly traced than the others and reproduce themselves on all the whorls of the spire."

It inhabits the coast of Peru near Payta. We have not seen any specimens belonging to this species, and have translated the above from the original description by D' Orbigny.

The figures referred to do not depict the specimen described. They represent a short, stout individual having *six* post-nuclear whorls of a light brown color, with about 12 strong axial ribs on the first, 18 on the fourth, and 20 on the penultimate whorl; and instead of four (three between the sutures) spiral lines the figure shows seven between the sutures and about an equal number on the base. D'Orbigny carefully points out that *C. cora* has only three strong spiral lines visible between the sutures, and compares it with *C. ornata*. We therefore are inclined to believe that some mistake has been made in the figures. The wrong specimen may have been figured or the artist may have figured *C. cora* wrongly.

TURBONILLA (PYRGISCUS) CRATICULATA Mörch.

Plate 10, figs. 1, *1a*.

Turbonilla craticulata MÖRCH, Malak. Blätt., vol. 6, 1859, p. 119.

Shell elongate-conic, brown. Nuclear whorls one and one-third, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fifth immersed. Post-nuclear whorls moderately rounded, slightly contracted at the periphery, and weakly shouldered at the summit; marked by moderately strong, straight, very regular, almost vertical axial ribs, of which 14 occur upon the first to third, 16 upon the third to sixth, 18 upon the seventh to ninth, and 22 upon the penultimate turn. Intercostal spaces a little wider than the ribs, marked by seven series of pits, which are a little wider than the raised spaces that separate them. The third of these pits anterior to the summit is a little stronger than the rest; the remainder are of equal strength and spacing. Sutures well impressed. Periphery and base of the last whorl well rounded, marked by the feeble continuations of the axial ribs. The base is marked by incised spiral lines, the first two anterior to the periphery being similar in character to those between the sutures; the rest are successively finer from the periphery to the umbilical region. Aperture ovate, somewhat effuse anteriorly, posterior angle acute; outer lip thin, showing the external sculpture within; columella oblique, slightly curved, and very strongly revolute, provided with a strong oblique fold a little anterior to its insertion; parietal wall covered by a thin callus.

Three specimens were dredged by Dr. A. S. Oersted in 30 fathoms at Los Bocorones, a small island near Punta Arenas, Costa Rica. This is Doctor Mörch's type lot in the museum in Copenhagen, Denmark. Our description and figure are taken from the most perfect specimen, which has eleven post-nuclear whorls, and measures: Length 7.8 mm., diameter 2. mm.

TURBONILLA (PYRGISCUS) CERALVA, new species.

Plate 10, figs. 5, *5a*.

Shell small, slender, milk-white. Nuclear whorls one and three-fourths, depressed, helicoid, having their axis at right angles to that of the succeeding turns, not immersed. Post-nuclear whorls very high between the sutures, moderately rounded, very slightly shouldered at the summit, and somewhat contracted at the sutures, marked by slender, curved, rounded, decidedly retractive axial ribs, which are very feebly expressed on the first whorl, on all the rest excepting the penultimate, which has 40, there are 36. Intercostal spaces about as wide as the ribs, marked by seven equal and equally spaced spiral pits. Periphery and base of the last whorl well rounded, the latter marked by the continuations of the axial ribs and eight equally spaced series of spiral pits, of which those nearest the umbilicus are a little less strongly developed than the rest. Aperture moderately large, oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, decidedly curved, and somewhat twisted.

The type (Cat. no. 162685, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2823, off La Paz, in 26½ fathoms. It has seven post-nuclear whorls and measures: Length 3.7 mm., diameter 0.8 mm. Another specimen (Cat. no. 206878, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2826, off Ceralvo Island, Gulf of California, in 9½ fathoms.

TURBONILLA (PYRGISCUS) LEPTA, new species.

Plate 10, figs. 7, *7a*.

Shell elongate-conic, very slender, milk-white. Nuclear whorls one and three-fourths, depressed, helicoid, having their axis at right angles to that of the succeeding turns, in the first of which they are very slightly immersed. Post-nuclear whorls slightly rounded, marked by well-developed, straight, rounded, strongly retractive axial ribs, of which there are 20 upon the first, 18 upon the second to sixth, and 20 upon the penultimate turn. Intercostal spaces about as wide as the ribs, marked by eight equal and equally spaced incised spiral lines. Sutures well impressed. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs and five equal and equally spaced incised spiral lines. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, curved, and slightly revolute.

The type (Cat. no. 162584, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2823 in 26½ fathoms, off La Paz, Lower California. It has eight post-nuclear whorls and measures: Length 2.7 mm., diameter 0.7 mm.

TURBONILLA (PYRGISCUS) HISTIAS, new species.

Plate 10, figs. 8, *8a*.

Shell elongate-conic, slender, posterior half between the sutures, light yellow; anterior half of base, chestnut. Nuclear whorls two, forming a depressed, helicoid spire, the axis of which is at right angles to that of the succeeding turns, upon the first of which it rests. Post-nuclear whorls slightly overhanging, flattened in the middle, very slightly shouldered at the summit, quite strongly contracted at the suture, marked by strong, somewhat sinuous, narrow, retractive axial ribs, of which 18 occur upon all but the penultimate turn, which has 24. Intercostal spaces about two times as wide as the ribs upon all but the last turn, upon which they are a little narrower, marked by eight equal and equally spaced spiral series of pits on all but the last two whorls; on these the third and fourth posterior to the periphery split into finer lines. Sutures well impressed. Periphery and base of the last whorl well rounded, marked by the axial ribs which extend undiminished to the umbilical area, and twelve incised spiral lines, of which those immediately below the periphery are the stronger. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, slightly twisted, decidedly curved, and somewhat revolute; parietal wall covered with a strong callus.

The type and two specimens (Cat. no. 162636, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2822, off La Paz, in 21 fathoms, on sand bottom off Lower California. The type has ten post-nuclear whorls and measures: Length 4.8 mm., diameter 1.1 mm.

TURBONILLA (PYRGISCUS) SUBULA Mörch.

Plate 10, fig. 3.

Turbonilla subula Mörch, Malak. Blätt., 1859, vol. 6, p. 120.

Shell of medium size, white. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle, moderately contracted at the suture, and slightly shouldered at the summit; ornamented by strong, somewhat flexuose, narrow, and slightly retractive axial ribs, of which about 16 occur upon the first of the remaining whorls, 18 upon the second and third, 20 upon the fourth to sixth, and 24 upon the penultimate turn. Intercostal spaces about as wide as the ribs, marked by nine subequal and subequally spaced incised spiral lines, which pass up on the sides of the ribs, but do not cross their summits. Sutures well impressed. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs, which extend to the umbilicus. The base has in addition a series of spiral striations, the first of which below the periphery is interrupted like those are between the sutures, separated by a little greater distance from the first one posterior to the periphery than that is from its neighbor posterior to it; the remaining are more or less continuous, less strong, wavy, and more closely spaced. Aperture suboval; posterior angle acute; outer lip thin; columella twisted and revolute; parietal wall covered with a thin callus.

The specimen described and figured is Doctor Mörch's type and is in the collection of the Copenhagen Museum. It was collected by Dr. A. S. Oersted at Los Bocorones, a small island near Punta Arenas, Costa Rica, in 30 fathoms. It has lost the early whorls; the last eight only remain, which measure: Length 4.9 mm., diameter 1.3 mm.

TURBONILLA (PYRGISCUS) WICKHAMI, new species.

Plate 10, fig. 9.

Shell elongate-conic, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle, contracted at the sutures, with a moderately broad, sloping shoulder at the summit marked by well-developed, rounded, very regular, slightly protractive axial ribs, of which 20 occur upon the second and 22 upon the remaining, excepting the penultimate whorl, which has 32. Intercostal spaces a little wider than the ribs, marked by seven series of spiral pits, of which the third below the summit is almost twice as wide as the rest. Sutures moderately constricted. Periphery of the last whorl well rounded. Base short, well rounded, marked by the continuations of the axial ribs, which extend to the umbilical area, and 11 incised spiral lines, of which those immediately below the periphery are somewhat interrupted and wider than the rest. Aperture rhomboidal; posterior angle acute; columella rather stout, revolute.

The type (Cat. no. 206879, U.S.N.M.) and three specimens were dredged by the University of California at station 32, off Santa Catalina Island, California. It has 10 post-nuclear whorls and measures: Length 8 mm., diameter, 2.1 mm.

Named for Prof. H. F. Wickham.

TURBONILLA (PYRGISCUS) LARA, new species.

Plate 10, figs. 6, *6a*, *6b*.

Shell small, slender, milk-white. Nuclear whorls two and one-fourth, forming a depressed, helicoid spire, having its axis at right angles to that of the succeeding turns, in the first of which it is very slightly immersed. Post-nuclear whorls flattened in the middle, rounding slightly toward the moderately shouldered summit, somewhat contracted at the suture, marked by fairly strong, straight, slightly retractive axial ribs, of which 18 occur upon the first and second and 20 upon all the remaining whorls excepting the penultimate turn, which has 22. Intercostal spaces varying from one and one-half to two times the width of the ribs, marked by nine series of spiral pits, of which the peripheral and the fifth above the periphery are the widest; the third and fourth above the periphery and the two immediately below the summit are a little narrower than the rest. The segments left between the pits form almost equal raised cords. Sutures well marked. Periphery of the last whorl and base moderately well rounded, ornamented by the continuations of the axial ribs and three strong, interrupted lines of pits on the posterior half and five slender lines on the anterior. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, curved, and slightly revolute. Parietal wall covered by a thin callus.

The type (Cat. no. 96707, U.S.N.M.) and sixty-six specimens were dredged at U. S. Bureau of Fisheries station 2823, off La Paz, in 27 fathoms. It has nine post-nuclear whorls and measures: Length 4.3 mm., diameter 2 mm.

The following specimens have been examined:

U.S.N.M. cat. No.	No. of specimens.	U. S. B. F. station.	Locality.	Depth, fathoms.	Disposition of material.
96707	66	2823	Off La Paz, Gulf of California	27	U. S. Nat. Mus.
162683	8	2822	.....do	21	Do.
191564	5	2826–2828	Off Ceralvo Island, Gulf of California.	9½–10	Do.
151929	31	2826–2828	.....do............................	9½–10	Do.

TURBONILLA (PYRGISCUS) CINCTELLA Mörch.

Plate 10, figs. 2, 2*a*, 2*b*.

Turbonilla cinctella Mörch, Malak. Blätt., vol. 6, 1859, p. 119.

Shell broadly elongate-conic, milk-white, with a faint broad yellowish band on the middle of the space between the sutures, a second narrow one at the periphery, a third at the insertion of the columella. Nuclear whorls two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls extremely regular, well rounded, appressed at the summit, somewhat contracted at the suture, marked by slender, somewhat sinuous, almost vertical axial ribs, of which 20 occur upon the first and second, 22 upon the third, 24 upon the fourth and fifth, and 26 upon the remaining turns. Intercostal spaces twice as wide as the ribs, marked by a series of moderately strong pits at the periphery and a second about half as broad, a little posterior to the middle of the whorls. In addition to these pits the intercostal spaces are marked by 28 slender, equally spaced and equally strong, incised spiral lines, 16 of which occur between the periphery and the median pit, and 12 between this and the summit. Sutures well impressed. Periphery and base of the last whorl well rounded, the latter marked by the continuation of the axial ribs, which extend feebly to the umbilical area, and slender spiral striations, which are stronger and more distantly spaced than those on the spire, growing successively weaker from the periphery to the columella. Aperture oval; posterior angle acute; out lip thin, showing the external markings within; columella almost straight, slightly revolute.

The type which has served us for our description and figure has nine post-nuclear whorls and measures: Length 5 mm. diameter 1.6 mm. It was collected by Dr. A. S. Oersted at Sonsonate, Guatemala, and is in the museum in Copenhagen, Denmark.

TURBONILLA (PYRGISCUS) ADUSTA, new species.

Plate 10, figs. 12, 12*a*.

Shell robust, pale brown. (Nuclear whorls decollated.) Post-nuclear whorls flattened, slightly exerted at the summit, where they are moderately squarely shouldered, marked by well developed, rounded, slightly retractive, axial ribs, of which 20 occur upon the second and third, 22 upon the fourth and fifth, 24 upon the sixth of the remaining turns, and 28 upon the penultimate whorl. Intercostal spaces equaling the ribs, crossed by a double series of spiral pits, five are strong and of equal strength, one of which is at the periphery, the other a little posterior to it, the third occupies the middle of the space between the sutures, while the other two divide the space posterior to this into three equal areas. The fine lines are arranged in the following manner: Between the second and third supra-peripheral pit, two fine lines; between the third and fourth, one; between the fourth and fifth, one; between the fifth and summit, two. Sutures well impressed, rendered sinuous by the ribs. Periphery of the last whorl marked by a broad band, crossed by the extensions of the axial ribs, which continue feebly over the well-rounded base to the umbilical area. In addition to these ribs, the base is marked by eleven incised spiral lines, the three immediately below the periphery being somewhat interrupted, the remaining are equal and equally spaced. Aperture ovate; posterior angle acute; columella slender, somewhat curved and reflected.

The type (Cat. no. 206880, U.S.N.M.) was collected at San Diego, California. It has lost the nucleus and probably the first post-nuclear whorl. The eight remaining measure: Length 5.7 mm., diameter 1.7 mm.

TURBONILLA (PYRGISCUS) LARUNDA, new species.

Plate 10, figs. 4, 4*a*, 4*b*.

Shell elongate-conic, milk-white, with a broad yellow band a little anterior to the middle of the whorls between the sutures. Nuclear whorls two, forming a depressed helicoid spire, which has its axis at right angles to that of the succeeding turns, upon the first of which it rests, but is not immersed. Post-nuclear whorls flattened in the middle, rounded at the summit, quite strongly contracted at the suture, ornamented by narrow, sinuous, well developed, retractive axial ribs, of which 16 occur upon the first to seventh, 18 upon the eighth to ninth, and 20 upon the penultimate turn. Intercostal spaces about three times as wide as the ribs, marked by eleven incised spiral lines, of which the three immediately below the summit and the one between the third and fourth above the periphery are finer than the rest, and the fourth and fifth below the summit and the peripheral one are of about equal width, and considerably stronger than the intervening four, which are subequal. Periphery of the last whorl well rounded. Base moderately long, well rounded, marked by the continuations of the axial ribs and seven strongly incised subequally spaced spiral lines, of which the three immediately below the periphery are somewhat interrupted and stronger than the rest.

Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender and somewhat sinuous.

The above description is based upon two cotypes which, together with a third specimen, were obtained at U.S. Bureau of Fisheries station 2822 in 21 fathoms, off La Paz, Lower California. They are entered as Cat. no. 206881, U.S.N.M. One of the two cotypes has the nucleus and nine post-nuclear whorls and measures: Length 3.6 mm., diameter 0.8 mm.; the other has lost the nucleus and probably the first four post-nuclear whorls, the seven remaining measure: Length 4.3 mm., diameter 1.2 mm.

Subgenus MORMULA A. Adams.

Mormula A. ADAMS, Journ. Linn. Soc. London, vol. 7, 1864, p. 1;+*Pyrgostylus* MONTEROSATO, Il. Nat. Hist. Sicil., 1884, p. 90. Type, *Turbo striatulus* Linnæus.

Turbonillas having axial ribs and deeply incised spiral lines; also irregularly disposed varices on the outer surface, which usually mark internal lirations on the outer lip, or internal lirations of the outer lip only. Sculpture never nodulose.

Type.—*Mormula rissoina* A. Adams.

KEY TO THE SPECIES OF THE SUBGENUS MORMULA.

- Varices present on the outside of the whorls.
  - Adult shell more than 16 mm. long.
    - Shell conspicuously banded.................................*lordi*, p. 111.
    - Shell not conspicuously banded.
      - Strongly incised lines between sutures 6, axial ribs 18–40...*regina*, p. 112.
      - Strongly incised lines between sutures 9, axial ribs 16–28.*catalinensis*, p. 113.
      - Strongly incised lines between sutures 12, axial ribs 16–26.*eschscholtzi*, p. 113.
  - Adult shell less than 13 mm. long.
    - Shell brown.
      - Strongly incised lines between sutures 5, axial ribs 16–24.*tridentata*, p. 114.
      - Strongly incised lines between sutures 10, axial ribs 16–22.*ambusta*, p. 115.
    - Shell white.
      - Shell large, adult more than 9 mm. long.....................*major*, p. 116.
      - Shell small, adult less than 4 mm. long................*santosana*, p. 117.
- Varices absent on the outside of the shell.
  - Spiral sculpture strong.
    - Shell brown.
      - Adult shell more than 8 mm. long...................*pentalopha*, p. 117.
      - Adult shell less than 6 mm. long.....................*heterolopha*, p. 118.
    - Shell white...*ignacia*, p. 119.
  - Spiral sculpture absent or microscopic.
    - Whorls shouldered.................................*periscelida*, p. 119.
    - Whorls not shouldered.................................*phalera*, p. 120.

TURBONILLA (MORMULA) LORDI E. A. Smith.

Plate 11, figs. 4, 4*a*.

Chemnitzia lordi E. A. SMITH, Ann. Mag. Nat. Hist., vol. 6, 1880, p. 288. *Turbonilla* (*Mormula*) *lordi* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 510, 511, pl. 45, figs. 7, 7*a*.

Shell very large, light brown to pale yellowish-white, variously banded. Nuclear whorls two, smooth, helicoid, moderately elevated, having their axis at right angles to the axis of the succeeding turns and about one-fourth immersed in the first of them. Post-nuclear whorls well rounded, ornamented by heavy, broad, low axial ribs, of which about 14 occur upon the second, 16 upon the eighth, 22 upon the eleventh, and 30 upon the penultimate whorl. Intercostal spaces not deeply depressed, about as wide as the ribs, ornamented by about 12 to 15 irregularly spaced spiral striations between the sutures; those near the summit of the whorls are closer and more feeble than those near the periphery of the whorls. Sutures strongly impressed, somewhat wavy. Periphery of the last whorl somewhat angulated in young specimens, moderately well rounded in adults. Base rather short, marked by faint continuations of the axial ribs and faint wavy spiral striation. Aperture subrhombic, posterior angle obtuse, outer lip thin, showing the external sculpture and banding within; columella stout, slightly twisted and revolute, provided with an oblique internal fold. The color markings in the specimen here described and figured consist of a pale yellowish-brown band, about a quarter of the width of the whorl between the sutures, covering the posterior part, followed by a narrow band of the yellowish-white ground color, which is followed by a band of brown a little darker than the first and about as wide as the last-named white band; then a broad pale white band, lastly a narrow pale yellow one above the periphery finishes the marking between the sutures. The periphery is marked by a narrow band of white followed by a deep brown one which shades gradually to the white about the umbilical region.

The characters which ally this species to *Mormula* are only feebly developed, now and then two ribs become fused and suggest a varix; the internal lirations, too, are only very feebly expressed and appear in the aperture of only one specimen. The specimen figured has 14 post-nuclear whorls and measures: Length 20.8 mm., diameter 5.1 mm. It was collected in 12 fathoms at Sitka Harbor, Alaska, and is Cat. no. 160492, U.S.N.M. No. 160069, U.S.N.M., contains 7 individuals from the same locality; no. 133234, U.S.N.M., has 2 from Port Orchard, Washington, and no. 4480, U.S.N.M., 1 from Puget Sound, Washington. Seven specimens were collected by Rev. G. W. Taylor at Banks Island, British Columbia. One of these, a young individual

(Cat. no. 196234, U.S.N.M.), has furnished the description of the nucleus. It has 9 post-nuclear whorls and measures: Length 5.2 mm., diameter 2.1 mm.

This is the largest species of this group known from the west coast of America.

TURBONILLA (MORMULA) REGINA, new species.

Plate 11, fig. 1.

Shell very large, elongate-conic, slender, pale chestnut. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, appressed at the summit, moderately constricted at the periphery, marked at irregular intervals by strong varices and by very regularly narrow, low, rounded, slightly protractive axial ribs, of which 16 occur upon the first and second, 18 upon the third, 22 upon the fourth, 24 upon the fifth to seventh, 30 upon the eighth and ninth, 36 on the tenth, 40 on the eleventh and the penultimate whorl. Intercostal spaces about one and one-half times as wide as the ribs, marked by 6 well incised spiral lines, which extend strongly upon the sides of the ribs and weakly over them; the space between these lines is marked by numerous exceedingly fine, spiral striations. Sutures constricted. Periphery of the last whorl slightly angulated, marked by an incised spiral line. Base short, well rounded, marked by the feeble continuations of the axial ribs and numerous very fine, closely spaced, wavy, spiral striations. Aperture rhomboidal; posterior angle obtuse; columella strong, almost straight, decidedly revolute.

The type (Cat. no. 162686, U.S.N.M.) was dredged at U.S. Bureau of Fisheries station 2902 in 15 fathoms, temperature 45°, off Santa Rosa Island, California. It has 13 post-nuclear whorls, having lost the nucleus and probably the first post-nuclear whorl, and measures: Length 19.6 mm., diameter 5 mm.

We have examined the following specimens:

U.S.N.M. cat. no.	No. of specimens.	U.S.B.F. station.	Locality.	Depth, fathoms.	Temperature, degrees.	Disposition of material.
162686......	1	2902.......	Santa Rosa Island, California.	15	45	U. S. Nat. Mus.
162687......	1	2901.......	.....do...................	48	55.1	Do.
160119......	1	....	Catalina Island, California.	....	....	Do.
	1	14[a].......	Off Point Fermin, California.	....	....	Univ. Cal. coll.
	1	21[a] (3)....	Off Catalina Island, California.	....	....	Do.
	1	32[a].......	.....do...................	....	....	Do.

[a] University of California station.

TURBONILLA (MORMULA) CATALINENSIS, new species.

Plate 11, figs. 10, 10*a*.

Shell elongate-conic, very slender. Nuclear whorls two and one-half, forming a depressed, helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls well rounded, with appressed summits, moderately constricted at the sutures, marked at irregular intervals by strong varices; axial ribs somewhat sinuous, low, well rounded, weakening toward the summit; 16 upon the first, 18 upon the second to eighth, 24 upon the ninth and tenth, 26 upon the eleventh and twelfth, 28 upon the thirteenth and penultimate turn. Intercostal spaces as wide as the ribs, marked by nine equally spaced spiral lines, which pass up on the sides of the ribs, but do not cross their summits; space between the incised spiral lines is marked by exceedingly fine spiral striations. Periphery of last whorl well rounded. Base short, well rounded, marked by the feeble continuations of the axial ribs, and seven well incised spiral striations. Aperture rhomboidal; posterior angle obtuse; outer lip thin, showing the external markings within; as well as four color bands, one of which is at the periphery, another midway between the periphery and summit, the third at the summit, the fourth on the middle of the base; in addition to these bands there are four strong spiral folds, two on the base and two on the lip, which show deeply within the aperture; columella slender, somewhat twisted and slightly revolute.

The type and another specimen (Cat. no. 160147, U.S.N.M.) were dredged off Catalina Island. The type has 16 post-nuclear whorls and measures: Length 16.5 mm., diameter 4 mm. Two specimens were dredged by the University of California, at station 21 (3) off Catalina Island, California.

TURBONILLA (MORMULA) ESCHSCHOLTZI Dall and Bartsch.

Plate 11, fig. 8.

Turbonilla (*Mormula*) *eschscholtzi* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 513, pl. 45, fig. 10.

Shell large, elongate-conic, brown, having three obscure bands of dark brown, one of which is at the summit, another at the periphery, while the third is halfway between these on the exposed portion of the whorl of the spire. Nuclear whorls decollated. Post-nuclear turns moderately rounded, ornamented by low, rounded, rather distantly spaced, slightly protractive axial ribs which become weakened and somewhat flattened as they approach the appressed summit, and many fine lines of growth both on the ribs and in the intercostal spaces. In addition to the axial sculpture the whorls are crossed by twelve deeply incised, somewhat irregularly spaced spiral lines, the raised spaces between which are again divided by many fine striæ. All the spiral markings pass over the intercostal spaces and the ribs. Periphery of the last whorl obscurely angular, marked by the feeble continuations of the ribs which vanish immediately below the periphery and the usual fine lines of growth and spiral striation. Base rather short, well rounded, brown, with a narrow whitish band about the umbilicus, marked by closely spaced continuous wavy spiral striation, which varies in strength, several finer striæ alternating with the stronger. Aperture subquadrate, outer lip thin, showing four narrow dark-brown bands within, upon a lighter background—these are the three already referred to—and a fourth one on the base adjoining the periphery; columella almost vertical, slightly twisted and revolute.

The type (Cat. no. 196241, U.S.N.M.) was collected by Rev. G. W. Taylor, at Carter Bay, British Columbia; it has 11 post-nuclear whorls (the nucleus and probably three of the post-nuclear whorls being lost), and measures: Length 13.3 mm., diameter 4 mm. Another specimen from the same locality is in the Taylor collection. Three additional lots were collected by him in British Columbia; 1, a fragment, from west of Rose Spit, Queen Charlotte Islands; 6 at Departure Bay, 1 of which is Cat. no. 196242, U.S.N.M.; 15 at Port Simpson, 5 of which are Cat. no. 196243, U.S.N.M. No. 196242 is the largest specimen, it has 12½ whorls, having lost the nucleus and probably the first three of the succeeding turns, and measures: Length 17.8 mm., diameter 4.5 mm.

TURBONILLA (MORMULA) TRIDENTATA Carpenter.

Plate 11, figs. 12, 12*a*.

Chemnitzia tridentata Carpenter, Jour. de Conch., vol. 13 (3d ser., vol. 5), 1865, p. 147. *Turbonilla* (*Lancea*) *tridentata* Dall and Bartsch, Mem. Cal. Acad., vol. 3, p. 273, 1903, pl. 2, figs. 1, 1*a*. *Turbonilla* (*Mormula*) *tridentata* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 511, 512, pl. 45, fig. 9.

Shell large, broad; chestnut colored, obscurely banded. Nuclear whorls three, helicoid, about one-third immersed, scarcely extending beyond the margin of the spire, their axis being at a right angle to the axis of the later whorls. Post-nuclear whorls slightly convex, somewhat contracted at the periphery and slightly shouldered at the summit; traversed by about 20 to 24 strong, well-rounded, somewhat oblique axial ribs, which continue faintly over the decidedly angular periphery of the last whorl and the base to the umbilical region; these ribs are considerably enfeebled on the last whorl of old shells and frequently become almost obsolete on these. The exposed portion of the whorls is traversed by five spiral grooves, which appear most prominently in the shallow and broad intercostal spaces, and less so on the ribs; these deep spiral lines are regularly spaced, leaving a broader interval on the middle of the exposed portion of the whorl; the base of the last whorl is likewise ornamented by spiral grooves, but here they appear less developed than on the spire. In addition to this the entire surface of the shell is marked by numerous very fine, somewhat wavy, spiral and axial striæ, which show most prominently on the last whorl and base, and give the shell a very minutely reticulated secondary sculpture. At irregular intervals the whorls are marked by thick callous varices, which are usually of a lighter color than the remainder of the shell. Aperture large, subquadrate; posterior angle acute; outer lip thin, having three strong internal lirations, joining the whitish, short, straight, revolute columella at a little less than a right angle. By transmitted light two spiral light color-bands become apparent on the inside of the lip, each of which is bordered by a zone of a darker color than the remaining shell. The general color effect of the exterior is that of a flesh-colored shell, covered by a dark epidermis, which is stretched tight over the ribs, permitting the lighter color beneath to shine through it at their summits.

Doctor Carpenter's type (Cat. no. 15315*b*, U.S.N.M.) was collected at Monterey, California. It has 11 post-nuclear whorls and measures: Length 11.1 mm., diameter 3.2 mm. The specimen figured (Cat. no. 150983, U.S.N.M.) is from San Pedro, California. It has 13 post-nuclear whorls and measures: Length 12.8 mm., diameter 3.6 mm.

The U. S. National Museum has five lots of this species: Cat. no. 15315*b* is the type from Monterey, California; Cat. no. 196239, four specimens dredged by the Bureau of Fisheries steamer *Albatross* at station 2902, off Santa Rosa Island, in 53 fathoms, fine gray sand and mud, with a bottom temperature of 45°; Cat. no. 196240, ten specimens from San Pedro, collected by Mrs. T. S. Oldroyd; Cat. no. 150983, three individuals, one of which is figured, dredged by Mrs. Oldroyd in 4 fathoms, at San Pedro; Cat. no. 46505, two shells from San Diego in the Stearns collection. In addition to these, specimens have been determined for Mr. Berry, from Monterey, 12 to 39 fathoms; University of California, off Catalina Island; Mrs. Oldroyd and Mr. Lowe, at San Pedro; Mr. Kelsey and Mr. Arnold, from San Diego.

TURBONILLA (MORMULA) AMBUSTA, new species.

Plate 11, fig. 13.

Shell medium size, slender, chestnut-brown. (Nuclear whorls decollated.) Post-nuclear whorls moderately rounded, appressed at the summit, slightly contracted at the periphery, marked by strong, rounded, slightly protractive axial ribs, of which 16 occur upon the first and second, 18 upon the third to seventh, the eighth has a strong varix, 20 upon the ninth, and 22 upon the tenth. On the penultimate whorl they are decidedly enfeebled. Intercostal spaces a little wider than the ribs, marked by ten equal and equally incised spiral lines, the space between which is crossed by numerous exceedingly fine spiral striations. Periphery and base of the last whorl well rounded, marked by fine lines of growth and numerous very fine spiral striations. Aperture rhomboidal; posterior angle obtuse; outer lip thin, showing the external sculpture within; also color bands, of which a narrow white one occurs at the periphery which is bounded on both sides by a brown band equaling it in width; another narrow brown band bordered on each side by a narrow white area occurs halfway between the periphery and the summit; columella slender, slightly curved and somewhat revolute.

The type (Cat. no. 152751, U.S.N.M.) was dredged in 10 fathoms, off San Pedro, California, by Mr. H. N. Lowe. It has lost the nucleus and probably the first post-nuclear whorl; the twelve remaining measure: Length 10 mm., diameter 2.3 mm. Another specimen from the same station is in Mr. Lowe's collection, and another was collected by Mrs. Oldroyd.

TURBONILLA (MORMULA) MAJOR C. B. Adams.

Plate 11, fig. 11.

Chemnitzia major C. B. Adams, Ann. Lyc. Nat. Hist. of N. Y., vol. 5, 1852, p. 391.

Shell elongate-conic, milk-white with a few irregular faint rust spots. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, appressed at the summit, moderately contracted at the periphery, with moderately strongly developed varices at irregular intervals and almost straight, well developed, vertical axial ribs, of which 16 occur upon the first to fourth, 18 upon the fifth to ninth, 20 upon the tenth to twelfth, and 24 upon the penultimate turn. Intercostal spaces about double the width of the ribs, marked by seven well-incised spiral lines, which, if the fourth were removed, would be equally spaced. The spaces between the strongly incised lines are marked by exceedingly fine spiral striations. Sutures slightly impressed. Periphery and base of the last whorl well rounded, posterior half of the latter marked by seven equal, well incised, wavy spiral lines; anterior half with exceedingly fine spiral striations only. Aperture rhomboidal; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella strong and somewhat twisted.

Professor Adams' type (Cat. no. 225 Amherst College) is the only specimen of this species we have seen. It has lost the nucleus and probably the first two post-nuclear turns. The fourteen remaining measure: Length 9.7 mm., diameter 2.5 mm. It comes from Panama.

TURBONILLA (MORMULA) SANTOSANA, new species.

Plate 11, fig. 7.

Shell broadly conic, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls inflated, well rounded, appressed at the summit, strongly contracted at the sutures, marked by strong, sublamellar, curved, slightly protractive axial ribs, of which 16 occur upon the second to fifth, 18 upon the sixth, and 20 upon the penultimate turn. Intercostal spaces about two times as wide as the ribs, terminating at the periphery, marked by a strong series of spiral pits at the periphery and six strongly incised lines, which are equally spaced, excepting the third and fourth below the summit, which are a little closer than the rest. Sutures strongly impressed. Periphery of the last whorl well rounded. Base short, well rounded, marked by three weakly incised, equally spaced, spiral striations. Aperture ?; outer lip re-enforced within by five strong spiral cords; three of which, a little weaker than the rest, are between the periphery and the summit, and two on the base; columella strong, twisted, and revolute, with an oblique fold near its insertion.

The type (Cat. no. 162689,U.S.N.M.) was dredged at U. S. Bureau, of Fisheries station 2830, in 66 fathoms, temperature 74.1°, off Todos Santos, Lower California. It has lost the nucleus and probably the first postnuclear turn; the eight remaining whorls measure: Length 3.7 mm., diameter 1.3 mm.

TURBONILLA (MORMULA) PENTALOPHA Dall and Bartsch.

Plate 11, figs. 3, 3*a*.

Turbonilla (*Lancea*) *pentalopha* Dall and Bartsch, Mem. Cal. Acad. Sci., vol. 3, 1903, p. 282, pl. 1, figs. 1, 1*a*.

Shell elongate-conic, chocolate-brown. Nuclear whorls small, three, forming a depressed, helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls rounded on the earlier and flattened on the later turns, marked by strong, rounded, somewhat flexuose, slightly retractive, axial ribs, which are scarcely at all expressed on the first, and of which there are 18 upon the first and second, 20 upon the third and fourth, 22 upon the fifth, 24 upon the sixth, and 28 upon the penultimate turn. Intercostal spaces as wide as the ribs, marked by six equal and equally spaced, spiral series of pits which pass up on the sides of the ribs, but do not cross them. Sutures well impressed. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs and seven equally spaced spiral striations, agreeing in strength with those on the spire. The first spiral line above and below the periphery are a little farther apart than the rest. Aperture large, oval; posterior angle acute; outer lip thin, showing the external sculpture within; provided with five strong, spiral cords, the anterior one of which is a little closer to its neighbor than the rest,which are equally spaced; columella moderately strong, curved, and revolute.

The type and 35 specimens (Cat. no. 46501, U.S.N.M.) were collected at San Diego, California. The type has ten post-nuclear whorls and measures: Length 8.5 mm., diameter 2.3 mm.

The following specimens have been examined:

U.S.N.M. Cat. no.	No. of specimens.	U.S.B.F. station.	Locality.	Depth, fathoms.	Disposition of material.
206885	1		San Pedro, California		U.S.Nat.Mus.
	4		do		Oldroyd coll.
46501	36		San Diego, California		U.S.Nat.Mus.
59328	5		do		Do.
206882	1	3564	do	5	Do.
206883	3	3566	do	3	Do.
206884	1		Southern California		U.S.Nat.Mus.
32284	1		Todos Santos Bay, Lower California		Do.

TURBONILLA (MORMULA) HETEROLOPHA, new species.

Plate 11, fig. 9.

Shell small, slender, chestnut-brown, with wax yellow apex. Nuclear whorls two and one-half, forming a depressed, helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is one-fourth immersed. Post-nuclear whorls flat, appressed at the summit, not constricted at the periphery, forming a spire of almost straight, uninterrupted outline. Axial sculpture consists of very broad, low, rounded, slightly retractive axial ribs, which are absent on the first turn but of which 20 occur upon the second to fourth, 28 upon the fifth and penultimate turn. Intercostal spaces very narrow, marked by six spiral lines of pits. Sutures poorly defined. Periphery and base of the last whorl well rounded, marked by the feeble continuations of the axial ribs and seven equally spaced, incised spiral lines. Aperture oval; posterior angle acute; outer lip thin, showing the external markings within; reënforced on the inside by four or five slender, equally spaced, spiral cords; columella strong, somewhat twisted.

The type and three specimens (Cat. no. 153065, U.S.N.M.) come from San Diego, California. The type has lost the nucleus; the seven post-nuclear whorls measure: Length 5.5 mm., diameter 1.8 mm. Cat. no. 162690, U.S.N.M., contains four specimens from San Hipolito Point, Lower California; collected by Mr. Henry Hemphill in whose collection there are five more from the same locality. Cat. no. 206886, U.S.N.M., one from San Diego, dredged in 12 fathoms.

TURBONILLA (MORMULA) IGNACIA, new species.

Plate 11, figs. 2, 2*a*.

Shell small, elongate-conic, milk-white. Nuclear whorls two and one-half, forming a depressed, helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fifth immersed. Post-nuclear whorls slightly rounded, appressed at the summit, moderately contracted at the suture, marked by low, rather broad, rounded, almost vertical axial ribs, of which 18 occur upon the second to fourth, 20 upon the fifth, 22 upon the sixth, 24 upon the seventh, and 28 upon the penultimate turn. Intercostal spaces a little narrower than the ribs, marked by six spiral series of well incised, equally spaced pits. Periphery and base of the last whorl well rounded, marked by the very feeble continuations of the axial ribs, and numerous exceedingly fine spiral striations. Aperture rhomboidal; posterior angle obtuse; outer lip thick, reenforced by two strong spiral lamellæ, one of which is a little posterior to the periphery and the other a little posterior to the middle between the periphery and the summit; columella rather strong, decidedly twisted with an oblique fold a little below its insertion.

The type and two other specimens (Cat. no. 162691, U.S.N.M.) comes from San Ignacio Lagoon, Lower California. The type has nine post-nuclear whorls and measures: Length 4.1 mm., diameter 1.2 mm.

TURBONILLA (MORMULA) PERISCELIDA, new species.

Plate 11, figs. 6, 6*a*.

Shell pupiform, milk-white, shining. Nuclear whorls small, two, forming a depressed, helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-half immersed. Post-nuclear whorls flattened, slightly contracted at the sutures, appressed at the summit, with a strong, sloping shoulder which extends over the posterior fourth of the space between the sutures, marked by strong, vertical axial ribs, of which about 14 occur upon all the whorls. These ribs become flattened and decidedly expanded on the shoulder. Intercostal spaces about three times as wide as the ribs, shallow, smooth. Sutures slightly constricted. Periphery of the last whorl somewhat attenuated, base well rounded, smooth. Aperture oval; somewhat effuse anteriorly; posterior angle acute; outer lip reënforced by three, broad, internal spiral lirations, two of which are posterior to the periphery and the other immediately below it; columella decidedly twisted and somewhat revolute; reënforced by the base, provided with a very strong, oblique fold at its insertion; parietal wall covered by a thin callus.

The type and two specimens (Cat. no. 163266, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2901, off Santa Rosa

Island, California, in 48 fathoms, temperature 55°.1. The type has seven post-nuclear whorls and measures: Length 3.2 mm., diameter 1 mm.

TURBONILLA (MORMULA) PHALERA, new species.

Plate 11, fig. 5.

Shell small, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, slightly contracted at the sutures, marked by moderately strong, curved, protractive axial ribs, of which 14 occur upon the first to fourth, 16 upon the fifth, and 18 upon the penultimate turn. Intercostal spaces a little wider than the ribs, well impressed, terminating at the periphery. Sutures well marked. Periphery of the last whorl slightly angulated. Base short, well rounded, smooth. Aperture rhomboidal; posterior angle obtuse; outer lip thick, with a single, strong, internal cord, a little posterior to the periphery; columella strong, somewhat twisted, with a weak fold near its insertion.

The type (Cat. no. 163267, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2794, in 62 fathoms, temperature 59°.6, in Panama Bay. It has seven post-nuclear whorls, having lost the nucleus and probably the first post-nuclear turn, and measures: Length 2.5 mm., diameter 0.8 mm.

Subgenus DUNKERIA Carpenter.

Dunkeria CARPENTER, Cat. Mazatlan Shells, 1856, pp. 433–434.

Turbonillas having the whorls stronger, rounded, and usually shouldered, marked by strong axial ribs and strong spiral cords, the junctions of which are frequently subnodulous.

Type.—Dunkeria subangulata.

Doctor Carpenter, after diagnosing *Dunkeria laminata,*[a] writes: "This beautiful Fenelloid species may be regarded as the type of the group of *Dunkeria.*" Unfortunately this species was not included in the original list, hence can not serve as type for the group. We had selected the first specimen, *Dunkeria paucilirata*, of the four cited by Carpenter in his Mazatlan Catalogue, for the type in our Synopsis of the Genera, Subgenera and Sections of the Family Pyramidellidæ.[b] Since then we have seen Doctor Carpenter's material in the British Museum and we find that *Dunkeria paucilirata* is a *Pyrgisculus*, and that the second species *Dunkeria subangulata* resembles *D. laminata* in form and sculpture and thus bears out the author's intent of typifying the group. *D. cancellata* must be removed to *Pyrgisculus* and *D. intermedia* to *Evalina.*

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[a] Ann. Mag. Nat. Hist., 1865, p. 396.

[b] Proc. Biol. Soc. Wash., vol. 17, 1904, p. 8.

KEY TO THE SPECIES OF THE SUBGENUS DUNKERIA.

- Spiral sculpture between the sutures of uniform character.
  - Spiral cords between the sutures 7½ .... *sedillina*, p. 121.
  - Spiral cords between the sutures 5 or 5½.
    - Adult shell more than 6 mm. long .... *laminata*, p. 122.
    - Adult shell less than 4 mm. long.
      - Whorls slightly rounded .... *hipolitensis*, p. 123.
      - Whorls strongly rounded.
        - Shell elongate-ovate.
          - Basal cords 5 .... *subangulata*, p. 124.
          - Basal cords 6 .... *andrewsi*, p. 124.
        - Shell elongate-conic .... *excolpa*, p. 123.
- Spiral sculpture between the sutures not of uniform character.
  - Adult shell more than 10 mm. long .... *arata*, p. 125.
  - Adult shell less than 6 mm. long .... *genilda*, p. 125.

TURBONILLA (DUNKERIA) SEDILLINA, new species.

Plate 12, figs. 3, 3*a*.

Shell elongate-conic, milk-white. Nuclear whorls two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is one-fourth mmersed. Post-nuclear whorls flattened in the middle, with a strong sloping shoulder, which extends over the posterior third between the sutures, appressed at the summit and slightly constricted at the suture, marked by slender, sublamellar, sinuous, almost vertical axial ribs, of which 16 occur upon the first three whorls, 18 upon the fourth to sixth, 20 upon the seventh and eighth, and 24 upon the penultimate turn. Intercostal spaces three times as wide as the ribs, marked by seven rather broad and deeply incised spiral grooves, the interspaces appearing as flattened cords, of which the one between the second and third groove below the summit is at the shoulder and a little broader than the rest. Sutures strongly constricted. Periphery of the last whorl somewhat angulated. Base short, well rounded, marked by seven irregular and irregularly spaced spiral striations. Aperture broadly oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, and decidedly curved.

The type and nine specimens (Cat. no. 162697 U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2823, in 26½ fathoms, off La Paz, Gulf of California. It has nine post-nuclear whorls and measures: Length 5.3 mm., diameter 1.4 mm. Cat. no. 206887, U.S.N.M., one specimen at U. S. Bureau of Fisheries station 2822, in 21 fathoms, also from La Paz. Cat. no. 206888 U.S.N.M., one specimen, from U. S. Bureau of Fisheries station 2826, 9½ fathoms, off Ceralvo Island, Gulf of California.

TURBONILLA (DUNKERIA) LAMINATA Carpenter.

Plate 12, figs. 16, 16*a*.

Dunkeria laminata CARPENTER, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 396.

Shell broadly conic, wax yellow at the tip, chestnut-brown on the last whorl, columellar area white. Nuclear whorls two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls inflated, strongly rounded, moderately contracted at the suture, marked by very regular, rounded, strong, almost vertical axial ribs, of which 18 occur upon the first, 24 upon the second, 26 upon the third, 28 upon the fourth and fifth, 30 upon the sixth and seventh, and about 40 upon the penultimate turn. Intercostal spaces a little wider than the ribs, crossed by five spiral series of broad, deep pits, which cause the five intermediate areas to appear as broad, raised bands, which are about as wide as the ribs, and render their junction with the ribs tuberculate. Sutures strongly impressed. Periphery of the last whorl well rounded. Base moderately long, marked by the faint continuations of the axial ribs, and about ten spiral lirations, which are narrower and less strongly developed about the umbilical area. Aperture broadly oval; posterior angle acute; outer lip thin, showing the external markings within; columella strongly curved, and completely reënforced by the base.

The specimen described and figured (Cat. no. 946*b*, U.S.N.M.) was collected by Cooper at San Pedro, California. It has nine post-nuclear whorls and measures: Length 6.6 mm., diameter 2.1 mm.

The coloration of this species varies considerably; it may be unicolor, white to chestnut, or diversely banded.

The following specimens have been examined:

U.S.N.M. Cat. no.	No. of specimens.	Locality.	Depth, fathoms.	Collector.	Disposition of material.
14946	3	San Pedro, California		Cooper	U. S. Nat. Mus.
130564	3	do		Oldroyd	Do.
	34	do		do	Do.
	62	do		do	Oldroyd coll.
		do		Roper	Roper coll.
		do		Lowe	Lowe coll.
		Terminal Island, California		Eshnaur	Eshnaur coll.
160111	3	Off Ballast Point (San Diego), California.	12–15	Kelsey	U. S. Nat. Mus.
153049	7	Ocean Beach, San Diego, California.		do	Do.
152315	1	do		do	Do.
152317	2	San Diego, California		do	Do.
109366	2	do		Hemphill	Do.
206891	1	San Diego, U. S. Bureau of Fisheries (station 3566).	3		Do.
	2	San Diego, California		Hemphill	Arnold coll.
	2	do		Lowe	Lowe coll.
	1	San Diego (Whites Point), California.		Oldroyd	Oldroyd coll.
	4	San Diego (foot of Ash street), California.		do	Do.
	1	Station 37, off San Diego, California.		Univ. Cal	Univ. Cal. coll.
	1	Station 32, off Catalina Island, California.		do	Do.
32284*b*	1	Todos Santos Bay, Lower California.		Hemphill	U. S. Nat. Mus.
106517	5	Point Abreojos, Lower California.		do	Do.

TURBONILLA (DUNKERIA) HIPOLITENSIS, new species.

Plate 12, figs. 8, 8*a*.

Shell milk-white, with a light yellow narrow band midway between the sutures. Nuclear whorls small, two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls moderately rounded, slightly shouldered at the summit but very slightly protracted at the suture, marked by moderately strong, rounded, retractive axial ribs, of which 18 occur upon the second, 20 upon the third, 24 upon the fourth and fifth, and 30 upon the penultimate turn. Intercostal spaces as wide as the ribs, crossed by five series of broad spiral pits, which are not quite as wide as the five raised cords which they bound, and which render the ribs somewhat nodulose at their junction. Periphery and base of the last whorl well rounded, the latter marked by six spiral cords and a feeble continuation of the axial ribs. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella moderately strong, curved, reënforced by the base.

The type and two additional specimens (Cat. no. 206889, U.S.N.M.) comes from San Hipolito Point, Lower California. The type has seven post-nuclear whorls and measures: Length 3.3 mm., diameter 1.2 mm.

TURBONILLA (DUNKERIA) EXCOLPA, new species.

Plate 12, figs. 4, 4*a*.

Shell wax yellow on the early whorls, ranging to chestnut brown on the last. Nuclear whorls two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls well rounded, marked by well-developed, narrow, rounded, almost vertical axial ribs, of which 24 occur upon the first to third, 26 upon the fourth, 28 upon the fifth, and about 36 upon the penultimate turn. Intercostal spaces about as wide as the ribs, crossed by five series of spiral pits which are as wide as the five raised spaces which they separate. The junction of these raised cords with the ribs renders them nodulous. Sutures constricted. Periphery of the last whorl and base well rounded, the latter marked by seven spiral cords. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within columella slender, somewhat twisted, reënforced by the base.

The type (Cat. no. 206892 U.S.N.M.) comes from the Gulf of California. It has seven post-nuclear whorls and measures: Length 3.7 mm., diameter 1.1 mm.

TURBONILLA (DUNKERIA) SUBANGULATA Carpenter.

Plate 12, fig. 11.

Dunkeria subangulata CARPENTER, Cat. Mazatlan Shells, 1856, p. 434.

Shell elongate-ovate, white. Nuclear whorls two, forming a moderately elevated spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls strongly rounded, obliquely shouldered at the summit, marked by slender, vertical, axial ribs, of which 20 occur upon the first, 22 upon the second and third, and 24 upon the penultimate turn. In addition to the axial ribs, the whorls are crossed by four slender, spiral cords between the sutures and by a fifth at the periphery and five on the base. The spaces inclosed by the ribs and cords appear as round pits. Periphery and base of the last whorl well rounded. Aperture suboval; outer lip thin; columella somewhat twisted and reflected; parietal wall covered with a thin callus.

An adult and a young specimen are on tablet 2008, Liverpool collection, British Museum. The adult has five post-nuclear whorls and measures: Length 2.8 mm., diameter 0.93 mm.

TURBONILLA (DUNKERIA) ANDREWSI, new species.

Plate 12, figs. 7, 7*a*.

Shell small, conic, light chestnut, umbilical area white. Nuclear whorls two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls well rounded, moderately contracted at the suture, with a sloping shoulder which extends over the posterior third between the sutures, marked by slender, well-rounded, slightly retractive axial ribs, of which 18 occur upon the first, 20 upon the second and third, 22 upon the fourth, and 32 upon the penultimate turn. Intercostal spaces about one and one-half times as wide as the ribs upon all but the last whorl, marked by five spiral series of broad pits, which are wide as the five cord-like interspaces which they bound and which render the ribs somewhat tuberculate at their junction. Sutures well impressed. Periphery and base of the last whorl well rounded, the latter marked by the continuation of the axial ribs, which extend feebly to the umbilical area, and six spiral cords which grow successively a little narrower from the periphery to the umbilical area. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella rather thick, reënforced by the base; parietal wall covered by a thin callus.

The type (Cat. no. 162696 U.S.N.M.) comes from Panama. It has six post-nuclear whorls and measures: Length 2.9 mm., diameter 1 mm.

Prof. C. B. Adams's type lot of *Chemnitzia clathratula* in the Amherst collection contains two specimens of this species. His type lot of *Chemnitzia communis* contains another specimen. Both lots are from Panama.

Named for Prof. Lancelot W. Andrews.

TURBONILLA (DUNKERIA) ARATA, new species.

Plate 12, fig. 12.

Shell large and rough. (Nuclear whorls decollated.) Post-nuclear whorls somewhat inflated and overhanging, appressed at the summit, well rounded, with the greatest convexity on the anterior third between the sutures; marked by strong, narrow, rounded, well raised, retractive axial ribs, of which 18 occur upon the first four, 20 upon the fifth, 22 upon the sixth and seventh, 24 upon the eighth, 26 upon the ninth, and 28 upon the penultimate turn. Intercostal spaces about twice as wide as the ribs, marked by very deep pits, which leave the intervening spaces as strongly elevated cords, nine of which occur between the sutures. Of these cords the second and fifth below the summit and the first above the periphery are of equal width and wider than the rest; the first, which forms the summit, and the three posterior to the one at the periphery are again of equal width; the third and fourth below the summit are a little more slender than the rest; the pit at the periphery and those that bound the fifth cord are a little wider than the rest; the first and second below the summit and the second and third pit above the periphery are equal and those between the third and fourth cords are also equal. Sutures well impressed. Periphery of the last whorl inflated. Base well rounded, marked by the feeble continuations of the axial ribs and eight almost equal incised spiral lines. Aperture large, oval; posterior angle acute; outer lip somewhat flaring in its middle; columella slender, curved, and slightly revolute.

The type (Cat. no. 206890, U.S.N.M.) was dredged off Santa Catalina Island, California. It has twelve post-nuclear whorls and measures: Length 10.2 mm., diameter 2.4 mm.

TURBONILLA (DUNKERIA) GENILDA, new species.

Plate 12, fig. 2.

Shell elongate-conic, white on the shoulder, the rest light brown. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle, well contracted at the sutures, with a strong sloping shoulder which extends over the posterior third between the sutures, rendering them angulated at its anterior termination. The whorls are marked by strongly elevated, narrow, axial ribs, which are vertical on the early whorls and decidedly retractive on the later ones. Intercostal spaces about two and one-half times as wide as the ribs, marked by a very broad, deep, peripheral pit and two less wide on the anterior third between the sutures; the median third is marked by three moderately broad pits, separated by slender lirations, the shoulder has a narrow line immediately below the summit and three well incised lines anterior to this, the anterior of which is less strongly developed than the other two. The spaces between the second and third, and third and fourth, posterior to the peripheral one, are wider than the rest. All the raised areas between the pits are crossed by very fine spiral striations. Periphery of the last whorl slightly angulated. Base short, well rounded, marked by the feeble continuations of the axial ribs and ten spiral striations, which decrease in size and spacing from the periphery to the umbilicus. Aperture rhomboidal; posterior angle obtuse; outer lip thin; columella slender, very oblique, and slightly revolute.

The type (Cat. no. 96806, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2799, in 30 fathoms, on green mud bottom in Panama Bay. It has lost the nucleus and probably the first postnuclear turn. The nine remaining measure: Length 5.3 mm., diameter 1.6 mm. Cat. no. 162694, U.S.N.M., contains three more specimens from the same station.

Subgenus PYRGISCULUS Monterosato.

Pyrgisculus MONTEROSATO, Conch. Medit., 1884, p. 28.

Turbonillas with turrited spire having the whorls decidedly contracted at the suture, and tabulated at the summit, marked on the spire and base by many well incised spiral lines.

Type.—*Melania scalaris* Philippi.

KEY TO THE SPECIES OF THE SUBGENUS PYRGISCULUS.

- Whorls shouldered.
  - Shoulder strongly excavated.
    - Axial ribs almost interrupted at the shoulder.............*monilifera*, p. 126.
    - Axial ribs continuing strong to the summit..............*cancellata*, p. 127.
  - Shoulder not excavated.
    - Axial ribs 12–8....................................*festiva*, p. 127.
    - Axial ribs 16–20..................................*eucosmia*, p. 128.
- Whorls not shouldered.
  - Spiral striations between the sutures 8.......................*paucilirata*, p. 129.
  - Spiral striations between the sutures 15..........................*swani*, p. 129.

TURBONILLA (PYRGISCULUS) MONILIFERA, new species.

Plate 12, fig. 15.

Shell pupiform, bluish-white. (Nuclear whorls decollated.) Postnuclear whorls flattened in the middle, scarcely contracted at the suture, with a strong shoulder that covers the posterior fourth between the sutures, forming a decided angle at its termination. The

TURBONILLA (DUNKERIA) HIPOLITENSIS, new species.

Plate 12, figs. 8, 8*a*.

Shell milk-white, with a light yellow narrow band midway between the sutures. Nuclear whorls small, two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls moderately rounded, slightly shouldered at the summit but very slightly protracted at the suture, marked by moderately strong, rounded, retractive axial ribs, of which 18 occur upon the second, 20 upon the third, 24 upon the fourth and fifth, and 30 upon the penultimate turn. Intercostal spaces as wide as the ribs, crossed by five series of broad spiral pits, which are not quite as wide as the five raised cords which they bound, and which render the ribs somewhat nodulose at their junction. Periphery and base of the last whorl well rounded, the latter marked by six spiral cords and a feeble continuation of the axial ribs. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella moderately strong, curved, reënforced by the base.

The type and two additional specimens (Cat. no. 206889, U.S.N.M.) comes from San Hipolito Point, Lower California. The type has seven post-nuclear whorls and measures: Length 3.3 mm., diameter 1.2 mm.

TURBONILLA (DUNKERIA) EXCOLPA, new species.

Plate 12, figs. 4, 4*a*.

Shell wax yellow on the early whorls, ranging to chestnut brown on the last. Nuclear whorls two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls well rounded, marked by well-developed, narrow, rounded, almost vertical axial ribs, of which 24 occur upon the first to third, 26 upon the fourth, 28 upon the fifth, and about 36 upon the penultimate turn. Intercostal spaces about as wide as the ribs, crossed by five series of spiral pits which are as wide as the five raised spaces which they separate. The junction of these raised cords with the ribs renders them nodulous. Sutures constricted. Periphery of the last whorl and base well rounded, the latter marked by seven spiral cords. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within columella slender, somewhat twisted, reënforced by the base.

The type (Cat. no. 206892 U.S.N.M.) comes from the Gulf of California. It has seven post-nuclear whorls and measures: Length 3.7 mm., diameter 1.1 mm.

TURBONILLA (DUNKERIA) SUBANGULATA Carpenter.

Plate 12, fig. 11.

Dunkeria subangulata CARPENTER, Cat. Mazatlan Shells, 1856, p. 434.

Shell elongate-ovate, white. Nuclear whorls two, forming a moderately elevated spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls strongly rounded, obliquely shouldered at the summit, marked by slender, vertical, axial ribs, of which 20 occur upon the first, 22 upon the second and third, and 24 upon the penultimate turn. In addition to the axial ribs, the whorls are crossed by four slender, spiral cords between the sutures and by a fifth at the periphery and five on the base. The spaces inclosed by the ribs and cords appear as round pits. Periphery and base of the last whorl well rounded. Aperture suboval; outer lip thin; columella somewhat twisted and reflected; parietal wall covered with a thin callus.

An adult and a young specimen are on tablet 2008, Liverpool collection, British Museum. The adult has five post-nuclear whorls and measures: Length 2.8 mm., diameter 0.93 mm.

TURBONILLA (DUNKERIA) ANDREWSI, new species.

Plate 12, figs. 7, 7*a*.

Shell small, conic, light chestnut, umbilical area white. Nuclear whorls two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls well rounded, moderately contracted at the suture, with a sloping shoulder which extends over the posterior third between the sutures, marked by slender, well-rounded, slightly retractive axial ribs, of which 18 occur upon the first, 20 upon the second and third, 22 upon the fourth, and 32 upon the penultimate turn. Intercostal spaces about one and one-half times as wide as the ribs upon all but the last whorl, marked by five spiral series of broad pits, which are wide as the five cord-like interspaces which they bound and which render the ribs somewhat tuberculate at their junction. Sutures well impressed. Periphery and base of the last whorl well rounded, the latter marked by the continuation of the axial ribs, which extend feebly to the umbilical area, and six spiral cords which grow successively a little narrower from the periphery to the umbilical area. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella rather thick, reënforced by the base; parietal wall covered by a thin callus.

The type (Cat. no. 162696 U.S.N.M.) comes from Panama. It has six post-nuclear whorls and measures: Length 2.9 mm., diameter 1 mm.

Prof. C. B. Adams's type lot of *Chemnitzia clathratula* in the Amherst collection contains two specimens of this species. His type lot of *Chemnitzia communis* contains another specimen. Both lots are from Panama.

Named for Prof. Lancelot W. Andrews.

TURBONILLA (DUNKERIA) ARATA, new species.

Plate 12, fig. 12.

Shell large and rough. (Nuclear whorls decollated.) Post-nuclear whorls somewhat inflated and overhanging, appressed at the summit, well rounded, with the greatest convexity on the anterior third between the sutures; marked by strong, narrow, rounded, well raised, retractive axial ribs, of which 18 occur upon the first four, 20 upon the fifth, 22 upon the sixth and seventh, 24 upon the eighth, 26 upon the ninth, and 28 upon the penultimate turn. Intercostal spaces about twice as wide as the ribs, marked by very deep pits, which leave the intervening spaces as strongly elevated cords, nine of which occur between the sutures. Of these cords the second and fifth below the summit and the first above the periphery are of equal width and wider than the rest; the first, which forms the summit, and the three posterior to the one at the periphery are again of equal width; the third and fourth below the summit are a little more slender than the rest; the pit at the periphery and those that bound the fifth cord are a little wider than the rest; the first and second below the summit and the second and third pit above the periphery are equal and those between the third and fourth cords are also equal. Sutures well impressed. Periphery of the last whorl inflated. Base well rounded, marked by the feeble continuations of the axial ribs and eight almost equal incised spiral lines. Aperture large, oval; posterior angle acute; outer lip somewhat flaring in its middle; columella slender, curved, and slightly revolute.

The type (Cat. no. 206890, U.S.N.M.) was dredged off Santa Catalina Island, California. It has twelve post-nuclear whorls and measures: Length 10.2 mm., diameter 2.4 mm.

TURBONILLA (DUNKERIA) GENILDA, new species.

Plate 12, fig. 2.

Shell elongate-conic, white on the shoulder, the rest light brown. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle, well contracted at the sutures, with a strong sloping shoulder which extends over the posterior third between the sutures, rendering them angulated at its anterior termination. The whorls are marked by strongly elevated, narrow, axial ribs, which are vertical on the early whorls and decidedly retractive on the later ones. Intercostal spaces about two and one-half times as wide as the ribs, marked by a very broad, deep, peripheral pit and two less wide on the anterior third between the sutures; the median third is marked by three moderately broad pits, separated by slender lirations, the shoulder has a narrow line immediately below the summit and three well incised lines anterior to this, the anterior of which is less strongly developed than the other two. The spaces between the second and third, and third and fourth, posterior to the peripheral one, are wider than the rest. All the raised areas between the pits are crossed by very fine spiral striations. Periphery of the last whorl slightly angulated. Base short, well rounded, marked by the feeble continuations of the axial ribs and ten spiral striations, which decrease in size and spacing from the periphery to the umbilicus. Aperture rhomboidal; posterior angle obtuse; outer lip thin; columella slender, very oblique, and slightly revolute.

The type (Cat. no. 96806, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2799, in 30 fathoms, on green mud bottom in Panama Bay. It has lost the nucleus and probably the first postnuclear turn. The nine remaining measure: Length 5.3 mm., diameter 1.6 mm. Cat. no. 162694, U.S.N.M., contains three more specimens from the same station.

Subgenus PYRGISCULUS Monterosato.

Pyrgisculus MONTEROSATO, Conch. Medit., 1884, p. 28.

Turbonillas with turrited spire having the whorls decidedly contracted at the suture, and tabulated at the summit, marked on the spire and base by many well incised spiral lines.

Type.—*Melania scalaris* Philippi.

KEY TO THE SPECIES OF THE SUBGENUS PYRGISCULUS.

Whorls shouldered.
  Shoulder strongly excavated.
    Axial ribs almost interrupted at the shoulder............. *monilifera*, p. 126.
    Axial ribs continuing strong to the summit............... *cancellata*, p. 127.
  Shoulder not excavated.
    Axial ribs 12-8.................................... *festiva*, p. 127.
    Axial ribs 16-20.................................... *eucosmia*, p. 128.
Whorls not shouldered.
  Spiral striations between the sutures 8...................... *paucilirata*, p. 129.
  Spiral striations between the sutures 15........................ *swani*, p. 129.

TURBONILLA (PYRGISCULUS) MONILIFERA, new species.

Plate 12, fig. 15.

Shell pupiform, bluish-white. (Nuclear whorls decollated.) Postnuclear whorls flattened in the middle, scarcely contracted at the suture, with a strong shoulder that covers the posterior fourth between the sutures, forming a decided angle at its termination. The whorls are marked by strong, axial ribs, of which 16 occur upon the second to fourth, 18 upon the fifth, and 20 upon the penultimate turn. Intercostal spaces about twice as wide as the ribs, marked by eleven incised spiral lines between the shoulder and the suture, which are a little less strongly developed and a little closer spaced near the suture. The shoulder is marked by five slender, spiral lines. Periphery and base of the last whorl well rounded, the latter marked by the feeble continuations of the axial ribs, and about eighteen slender, incised spiral lines. Aperture broadly oval; posterior angle acute; outer lip rather thick; columella decidedly curved and somewhat twisted.

The type (Cat. no. 58334, U.S.N.M.) comes from the Gulf of California. It has lost the nucleus. The seven remaining whorls measure: Length 5.6 mm., diameter 1.8 mm.

TURBONILLA (PYRGISCULUS) CANCELLATA Carpenter.

Plate 12, fig. 6.

Dunkeria cancellata CARPENTER, Cat. Mazatlan Shells, 1856, p. 435.

Shell reddish-brown. Nuclear whorls two, tumid, helicoid, having their axis at right angles to that of the succeeding turns. Post-nuclear whorls two and one-half, decidedly inflated, strongly angulated at the summit; marked by many acute axial ribs and somewhat less strong spiral threads, which render the whorls elegantly cancellated. Outer lip angulated, columella without fold.

Doctor Carpenter's type was found on a specimen of *Spondylus* at Mazatlan, Mexico. It is preserved in the Liverpool collection on tablet 2009 in the British Museum. This young individual has two and one-half post-nuclear whorls, measuring: Length 0.95 mm., diameter 0.5 mm. It has very strong tabulated shoulders, acute lamellar axial ribs, of which about eighteen occur on the last whorl, and fine, spiral striations in the broad intercostal spaces.

TURBONILLA (PYRGISCULUS) FESTIVA De Folin.

Plate 12, fig. 5.

Turbonilla festiva DE FOLIN, Les Méléagrinicoles, 1867, pp. 49, 50, pl. 5, figs. 4–6.

Shell smooth, vitreous, elongate-conic. Nuclear whorls two and one-half, forming a moderately elevated, helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fifth immersed. Post-nuclear whorls moderately rounded, strongly contracted at the sutures, having a strong sloping shoulder which extends over the posterior fourth of the space between the sutures; the whorls are crossed by strong lamellose axial ribs which extend over the periphery to the umbilical area. Ten of these occur upon the first, 12 upon the second, and 8 upon the remaining turns. Intercostal spaces about eight times as wide as the axial ribs, crossed by fine spiral striations, of which about fourteen occur between the sutures. Base slightly excavated. Aperture oval; columella decidedly curved.

The type has five post-nuclear whorls and measures: Length 2.5 mm., diameter 0.6 mm.

The species described in Les Méléagrinicoles were taken from pearl oysters which are said to have come from Negritos and the Margarita Island in the Bay of Panama. No specific station is cited for this species. It has been referred to Panama by Tryon in his Manual of Conchology.

TURBONILLA (PYRGISCULUS) EUCOSMIA, new species.

Plate 12, figs. 13, 13*a*.

Shell pupoid, light yellow, with a narrow, darker band at the shoulder. Nuclear whorls one and three-fourths, forming a depressed, helicoid spire, the axis of which is at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls slightly flattened in the middle, with a strong sloping shoulder which extends over the posterior fourth between the sutures and renders them decidedly angulated at its anterior termination; slightly contracted at the suture, marked by strong, sublamellar, axial ribs, which are vertical on the first four whorls and decidedly retractive on the later ones. Of these ribs, 16 occur upon the first five whorls, 18 upon the sixth, and 20 upon the penultimate turn. Intercostal spaces about two and one-half times as wide as the ribs, marked by a double series of very broad pits, one of which is at the periphery and the other immediately anterior to the shoulder. The space between these pits is divided into four equal cords by three moderately wide pits, the cords in turn being divided by a fine incised line. The shoulders are marked by five equal and equally spaced, incised, spiral lines. Sutures strongly impressed. Base moderately long, well rounded, marked by eight almost equal and equally spaced spiral striations. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, sinuous, and strongly reflected; parietal wall covered with a strong callus.

The type (Cat. no. 162698, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2822, in 21 fathoms, off La Paz, Lower California. It has eight post-nuclear whorls and measures: Length 4.8 mm., diameter 1.4 mm. Two additional specimens (Cat. no. 163251*a*, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2827, in 10 fathoms, off Ceralvo Island, Gulf of California.

TURBONILLA (PYRGISCULUS) PAUCILIRATA Carpenter.

Plate 12, fig. 10

Dunkeria paucilirata CARPENTER, Cat. Mazatlan Shells, 1856, p. 434.

The type and only known individual of this species is an imperfect specimen mounted on tablet 2007 of the Liverpool collection in the British Museum.

The nucleus is two-thirds immersed, and the axis is at right angles to that of the succeeding turns. Post-nuclear whorls strongly rounded, well constricted at the sutures; moderately slender, almost vertically curved axial ribs, of which 16 occur upon the first and about 18 upon the rest of the turns. Intercostal spaces very broad, shallow, marked by fine spiral striations. Sutures strongly constricted. It has five post-nuclear whorls and measures: Length 2.1 mm., diameter 0.7 mm.

The specimen was collected on a *Chama* at Mazatlan, Mexico.

TURBONILLA (PYRGISCULUS) SWANI, new species.

Plate 12, figs. 9, *9a*.

Shell elongate, pupoid, semitransparent, light yellow. Nuclear whorls at least two, forming a low helicoid spire, whose axis is almost at right angles to that of the succeeding turns, in the first of which it is about one-half immersed. Post-nuclear whorls inflated, very strongly rounded, appressed at the summit, contracted at the periphery, marked by strong, decidedly curved, lamellar, protractive axial ribs, of which 18 occur upon all but the last whorl, the latter has 20. Intercostal spaces twice as wide as the ribs, marked by 15 almost equal and almost equally spaced spiral series of pits. Sutures constricted. Periphery and base of the last whorl well rounded, the latter marked by the feeble continuations of the axial ribs, and about 20 feeble very wavy incised spiral lines. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, curved, with the posterior two-thirds reënforced by the base.

The type (Cat. no. 160485, U.S.N.M.) comes from San Pedro, California. It has eight post-nuclear whorls and measures: Length 5 mm., diameter 1.5 mm.

Named for J. G. Swan.

Subgenus ASMUNDA Dall and Bartsch.

Asmunda DALL and BARTSCH, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 9.

Shell with strong axial ribs which terminate at the keeled periphery; base with many axial riblets, a strong median spiral cord, and a constriction between this and the peripheral keel.

Type.—*Chemnitzia turrita* C. B. Adams.

TURBONILLA (ASMUNDA) TURRITA C. B. Adams.

Plate 12, figs. 14, 14*a*.

Chemnitzia turrita C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., vol. 5, 1852, pp. 393, 394.

Shell elongate-conic, milk-white. Nuclear whorls small, two and one-half, forming an elevated helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls moderately well rounded, with a very broad, flat, tabulated summit, marked by strong, lamellar, somewhat sinuous, almost vertical axial ribs, of which 18 occur upon the first, 14 upon the second to fifth, 16 upon the sixth, 18 upon the seventh, 20 upon the eighth, and 24 upon the penultimate whorl. Intercostal spaces about four times as wide as the ribs, deeply impressed, smooth. Sutures very strongly marked. Periphery of the last whorl marked by a strong keel, middle of the base with a strong tumid fasciole, the space between which and the periphery forms a shallow, well-rounded channel. Umbilical area slightly excavated. In addition to this sculpture, the base is crossed by many, subequal, slender, raised axial threads, which do not correspond to the axial ribs, between the sutures. Aperture irregular; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella strong and slightly curved.

Cat. no. 230 of Professor Adams's Panama Shells, in Amherst College, contains two specimens, the cotypes. We have selected the better of the two for our description and figure. This has 10 post-nuclear whorls and measures: Length 4.7 mm., diameter 1.3 mm. In the same collection, no. 251, *Rissoa,* sp. indet., a fragment, belongs here.

Subgenus CARELIOPSIS Mörch.

Careliopsis MÖRCH, Malak. Blätt., 1874, p. 169.

Turbonillas having the surface marked by many subequal well-impressed spiral lines and numerous feeble axial riblets. Under low magnification the sculpture appears to consist of impressed pitted spiral lines only.

Type.—*Monoptygma* (*Careliopsis*) *styliformis* Mörch.

TURBONILLA (CARELIOPSIS) STENOGYRA, new species.

Plate 12, figs. 1, 1*a*.

Shell acicular, transparent. Nuclear whorls small, two, forming a depressed, helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is very slightly immersed. Post-nuclear whorls slightly rounded, somewhat contracted immediately below the sutures which causes the summits to appear somewhat exserted. The first three post-nuclear whorls show traces of axial ribs on the posterior half of the whorls. Of these there appear to be about 18 upon the third turn. The whorls are marked by spiral lines of well-impressed pits, of which 6 appear upon the first, 7 upon the second, 8 upon the third and fourth, 10 upon the fifth, 11 upon the sixth, 14 upon the seventh, and 18 upon the penultimate turn, between the sutures. Upon the last, they are more or less irregular. Sutures poorly marked. Periphery of the last whorl well rounded. Base moderately long, well rounded, marked by 11 spiral lines of pits. Aperture oval; posterior angle acute; outer lip thin, showing the external markings within; columella moderately strong, very strongly curved, reënforced by the base.

The type and another specimen (Cat. no. 162699, U.S.N.M.) comes from San Hipolito Point, Lower California. The type has nine post-nuclear whorls and measures: Length 5.5 mm., diameter 1.2 mm.

Genus ODOSTOMIA Fleming.

Odostomia FLEMING, Edinburgh Encycl., vol. 7, 1817, pt. 1, p. 76.=*Odontostomia* JEFFREYS, Mal. and Conch. Mag., 1839, p. 33.=*Turritostomia* SACCO, Moll. del Piemonte e della Liguria, 1892, p. 41, same type.

Shell with sinistral apex, usually short, few whorled, subconic or ovate, with a single columellar fold which varies in strength and sometimes is not apparent at the aperture. The sculpture varies from smooth to lamellar axial ribs and spiral keels.

Type.—*Turbo plicatus* Montagu.

Of the forty subgenera now recognized under Odostomia nineteen have been found represented on the west coast of America.

KEY TO THE SUBGENERA OF ODOSTOMIA.

Early post-nuclear whorls sculptured differently from the later ones. *Lysacme*, p. 132.
Post-nuclear whorls sculptured similarly throughout.
  Varices present .... *Salassiella*, p. 133.
  Varices absent.
    Axial ribs present.
      Axial ribs rounded.
        Spiral markings absent or if present consisting of microscopic striations only .... *Salassia*, p. 134.
        Spiral markings consisting of several to many raised threads.
          Spiral sculpture less strong than axial, not nodulous. *Besla*, p. 135.
          Spiral sculpture equal to the axial, nodulose between the sutures .... *Chrysallida*, p. 136.
        Spiral markings consisting of incised lines.
          Spiral lines on spire and base .... *Pyrgulina*, p. 169.
          Spiral lines on base only .... *Egila*, p. 170.
      Axial ribs lamellar.
        Spiral sculpture lamellar.
          Intersection of axial and spiral sculpture cuspidate, *Haldra*, p. 171.
          Intersection of axial and spiral sculpture not cuspidate, *Ividella*, p. 172.

Post-nuclear whorls sculptured similarly throughout—Continued.
  Varices absent—Continued.
    Axial ribs present—Continued.
      Axial ribs feeble, usually only indicated near the summit of the whorls.
        Spiral sculpture consisting of several strong, broad cords, one or more of the posterior of which are crenulated........... *Miralda*, p. 176.
        Spiral sculpture consisting of many subequal lirations.
          Whorls tabulated at the summit.................... *Ivara*, p. 179.
          Whorls not tabulated at the summit............ *Evalina*, p. 180.
      Axial sculpture reduced to mere lirations, frequently only present between the spiral cords.
        Shell umbilicated.................................. *Iolæa*, p. 181.
        Shell not umbilicated............................ *Menestho*, p. 184.
      Axial sculpture represented by lines of growth only.
        Spiral markings consisting of well incised lines....... *Evalea*, p. 192.
        Spiral markings consisting of many fine wavy striations, *Amaura*, p. 218.
        Spiral sculpture consisting of a strong peripheral keel, *Scalenostoma*, p. 229.
        Spiral sculpture absent.
          Aperture rissoid................................ *Heida*, p. 231.
          Aperture not rissoid......................... *Odostomia*, p. 231.

Subgenus LYSACME Dall and Bartsch.

Lysacme DALL and BARTSCH, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 14.

Early post-nuclear whorls loosely coiled, plain, later ones closely coiled with a spiral keel at the periphery and another at the summit of the whorl; base spirally lirate.

Type.—*Chrysallida clausiliformis* Carpenter.

ODOSTOMIA (LYSACME) CLAUSILIFORMIS Carpenter.

Plate 13, fig. 2.

?? *Chrysallida clausiliformis* CARPENTER, Cat. Mazatlan Shells, 1856, p. 426.

Shell clausiliform. Nuclear whorls two, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is scarcely at all immersed. First two and one-half post-nuclear whorls loosely coiled, strongly rounded, smooth, separated by very strongly impressed sutures. Remaining whorls moderately rounded, with a strong spiral cord at the summit and another at the periphery, the two being closely appressed at the sutures. Base prolonged, marked by low spiral cords. Aperture irregularly oblong, decidedly effuse anteriorly; columella provided with a strong fold at its insertion. Operculum paucispiral.

Four specimens were taken off *Chama* at Mazatlan, of which the best preserved is on tablet 1987, Liverpool collection, British Museum, which has seven post-nuclear whorls and measures: Length 3.8 mm., diameter 0.9 mm.

It is a curious shell, entirely different from anything else that we have seen. Unfortunately the outer surface is too badly worn to permit of a positive statement regarding its finer markings.

SALASSIELLA, new subgenus.

Shell pupiform, whorls inflated, marked by axial ribs which extend undiminished from the summit to the umbilical area. Varices strong, irregularly distributed.

Type.—Odostomia (*Salassiella*) *laxa* Dall and Bartsch.

KEY TO THE SPECIES OF THE SUBGENUS SALASSIELLA.

Summit of the whorls rounded	*laxa.*
Summit of the whorls tabulated	*richi.*

ODOSTOMIA (SALASSIELLA) LAXA, new species.

Plate 13, figs. 8, 8*a*.

Shell pupiform, milk-white. Nuclear whorls at least two, small, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about two-thirds immersed. Post-nuclear whorls inflated, contracted at the sutures, and strongly roundedly shouldered at the summit, marked by lamellar, flexuose axial ribs, which are only feebly expressed on the first. On the second there are 18, on the third 20, 22 upon the fourth, and 28 upon the penultimate turn, upon which there is a strong varix. Intercostal spaces about one and one-half times as wide as the ribs, well impressed. Sutures constricted. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs. Aperture broadly oval; posterior angle obtuse; outer lip thin; showing the external sculpture within; columella slender, strongly curved, and slightly revolute, provided with a weak fold at its insertion.

The type and another specimen (Cat. no. 106512, U.S.N.M.) comes from Scammon Lagoon, Lower California. It has six post-nuclear whorls, and measures: Length 4.3 mm., diameter 1.7 mm. Another specimen (Cat. no. 286893, U.S.N.M.) comes from San Diego, California.

ODOSTOMIA (SALASSIELLA) RICHI, new species.

Plate 13, figs. 6, 6*a*.

Shell small, broadly conic, white. Nuclear whorls three, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls strongly rounded, moderately contracted at the suture, broadly tabulated at the shoulder, marked by strong, lamellar, axial ribs, of which 16 occur upon the first, 14 upon the second and third, and 18 upon the penultimate turn. Intercostal spaces somewhat wider than the ribs, strongly impressed. Periphery of the last whorl marked by a broad, low keel. Base with a strongly raised tumescence about the umbilical area, the space between which and the peripheral keel appears slightly concave. The axial ribs continue weakly over the base. A strong varix appears on the last whorl, between two axial ribs, and extends from the summit to the umbilical chink. Aperture suboval; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella strong, straight, and decidedly revolute; parietal wall covered by a thin callus.

The type (Cat. no. 160484, U.S.N.M.) comes from San Pedro, California. It has five and one-half post-nuclear whorls, and measures: Length 3 mm., diameter 1.4 mm.

Subgenus SALASSIA De Folin.

Salassia De Folin, Const. d. Chemnitzidæ, 1885, p. 15.

Shell pupiform, whorls not inflated, marked by axial ribs which extend from the tabulated summit of the whorl to the umbilical area. Varices absent.

Type.—*Salassia tropidita* Dall and Bartsch.

KEY TO THE SPECIES OF THE SUBGENUS SALASSIA.

Summit of the whorls tabulated .... *tropidita*, p. 134.
Summit of the whorls rounded .... *scalariformis*, p. 135.

ODOSTOMIA (SALASSIA) TROPIDITA, new name.

Plate 13, fig. 3.

Salassia carinata De Folin, Fonds de la Mer, vol. 2, 1872, p. 168, pl. 6, fig. 6; not *Scalenostoma carinata* Deshayes, 1863, nor *Odostomia carinata* H. Adams, 1873.

Shell pupiform, white. Nuclear whorls one and one-half, forming a moderately elevated helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-third immersed. Post-nuclear whorls moderately rounded, somewhat contracted at the sutures, strongly tabulated on the summits, marked by rounded, weak, axial ribs of which 8 occur upon the first and second, 10 upon the third, 12 upon the fourth and fifth, and 14 upon the penultimate turn. Intercostal spaces broad and shallow. Periphery of the last whorl and base well rounded, marked by the continuation of the ribs. Aperture broadly oval; outer lip thin; columella slender, slightly curved.

De Folin's type comes from Isle of Pearls, Bay of Panama. It has seven post-nuclear whorls, and measures: Length 2.5 mm., diameter 1.2 mm.

ODOSTOMIA (SALASSIA) SCALARIFORMIS Carpenter.

Plate 13, fig. 1.

Parthenia scalariformis CARPENTER, Cat. Maz. Shells, 1856, p. 413.

Shell pupiform, white. Nuclear whorls small, almost completely immersed. Post-nuclear whorls well rounded, scarcely at all contracted at the periphery, strongly roundedly shouldered at the summit, marked by slender, distant, scalariform, retractive axial ribs, of which about 20 occur upon the first and 16 upon the remaining turns. Intercostal spaces very broad, shallow. Sutures strongly marked. Periphery and the somewhat prolonged base of the last whorl well rounded, marked by the undiminished continuations of the axial ribs, which extend to the umbilical chink. Aperture ovate; outer lip thin; columella slender, curved, provided with a moderately strong fold at its insertion; parietal wall covered with a thick callus.

Two specimens of this species were found on *Chama* at Mazatlan. Tablet 1962 of the Liverpool collection in the British Museum contains the finest of the two. This has six post-nuclear whorls, and measures: Length 5 mm., diameter 0.93 mm.

Subgenus BESLA Dall and Bartsch.

Besla DALL and BARTSCH, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 10.

Small *Odostomias* with axial ribs and three strong spiral raised threads, one at and two posterior to the periphery between the sutures; base marked by raised spiral threads.

Type.—*Chrysallida convexa* Carpenter.

KEY TO THE SPECIES OF THE SUBGENUS BESLA.

Whorls overhanging..*convexa*, p. 135.
Whorls flattened..*callimorpha*, p. 136.

ODOSTOMIA (BESLA) CONVEXA Carpenter.

Plate 13, fig. 4.

Chrysallida convexa CARPENTER, Cat. Mazatlan Shells, 1856, p. 424.

Shell small, slender, elongate-conic. Nuclear whorls two and one-half, forming a moderately elevated helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fifth immersed. Post-nuclear whorls overhanging, strongly contracted at the sutures, appressed at the summit, angulated at the posterior extremity of the anterior third; between the sutures, marked by strong, rounded, sinuous, almost vertical axial ribs, of which 16 occur upon the second and third, 18 upon the fourth, and 22 upon the penultimate turn. Intercostal spaces a little more than twice as wide as the ribs, crossed by three equal and equally spaced spiral cords, which are about one-half as strong as the ribs. The first of these cords is at the periphery, the third at the posterior termination of the anterior third between the sutures, which it renders strongly angulated. Sutures constricted. Periphery and base of the last whorl well rounded, marked by the continuation of the axial ribs, and about eight slender spiral lirations. Aperture broadly oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, slightly curved, decidedly oblique and revolute, provided with a slender fold at its insertion; parietal wall covered with a strong callus.

Two specimens (Cat. no. 162734, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2823, in 26 fathoms, on broken shell bottom, off Cacachitas, Gulf of California. The larger of the two specimens has six post-nuclear whorls and measures: Length 2.4 mm., diameter 0.7 mm.

The type which is on tablet 1984, Liverpool collection, British Museum, and another specimen were collected on *Spondylus* at Mazatlan.

ODOSTOMIA (BESLA) CALLIMORPHA, new name.

Plate 13, fig. 5.

Chrysallida pumila Carpenter, Proc. Cal. Acad. Sci., vol. 3, 1866, p. 219; not *Odostomia pumila* A. Adams, 1861.

Shell very small, pupiform, milk-white. Nuclear whorls completely immersed. Post-nuclear whorls flattened, slightly contracted at the sutures, moderately shouldered at the summit, marked by strong, depressed, rounded, almost vertical axial ribs, of which 22 occur upon all but the first whorl, which is smooth. Intercostal spaces about as wide as the ribs, crossed by three slender, spiral lirations on the anterior half of the whorls between the sutures. Sutures subchanneled. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs, which extend almost undiminished to the umbilical area and five equal slender, spiral lirations on the posterior half of the base. Aperture broadly oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella strongly curved, slightly revolute, reënforced on its posterior half by the base, provided with a strong fold at its insertion.

The type (Cat. no. 15565, U.S.N.M.) comes from San Pedro, California. It has five post-nuclear whorls and measures: Length 1.5 mm., diameter 0.6 mm.

Subgenus CHRYSALLIDA Carpenter.

Chrysallida Carpenter, Cat. Mazatlan Shells, 1856, p. 416.=*Noëmia* De Folin, Fonds de la Mer, 1873, p. 314. Type.—*Noëmia angusta* De Folin; *Noëmiamea* De Folin, Zool. Rec., 1885, p. 94 (Mollusca). Same type. Not *Noëmia* Pasco, 1857.

Odostomias having strong axial ribs crossed by equally strong spiral keels between the sutures, the intersection of these two elements forming nodules. The axial ribs pass only faintly over the base, while the spiral sculpture remains quite prominent.

Type.—*Odostomia* (*Chrysallida*) *torrita* n. n. = *Chrysallida communis* Carpenter; not *Chemnitzia* [= *Chrysallida*] *communis* C. B. Adams.

KEY TO THE SPECIES OF THE SUBGENUS CHRYSALLIDA.

- All spiral cords between the sutures nodulose.
  - Sutures strongly channeled.
    - Axial ribs always stronger than the spiral cords.
      - Basal cords 5 .... *reigeni*, p. 138.
      - Basal cords 6 .... *inconspicua*, p. 139.
      - Basal cords 7 .... *telescopium*, p. 139.
      - Basal cords 8 .... *excelsa*, p. 140.
      - Basal cords 9 .... *acrybia*, p. 141.
      - Basal cords 10 .... *communis*, p. 141.
      - Basal cords 12.
        - Outer lip of adult shell pinched in .... *torrita*, p. 142.
        - Outer lip of adult shell not pinched in.
          - Axial ribs of last whorl 16 .... *licina*, p. 143.
          - Axial ribs of last whorl 22 .... *talama*, p. 143.
    - Axial ribs not as strong as the spiral cords.
      - Spiral cords 4 between the sutures on the later whorls.
        - Shell slender, elongate-conic.
          - Basal cords 8.
            - Diameter more than 1 mm .... *effusa*, p. 144.
            - Diameter less than 1 mm .... *paupercula*, p. 144.
          - Basal cords 7 .... *clathratula*, p. 145.
          - Basal cords 6.
            - Adult shell 4.5 mm. long .... *ritteri*, p. 146.
            - Adult shell 2.3 mm. long .... *rinella*, p. 146.
          - Basal cords 5 .... *eugena*, p. 147.
        - Shell ovate or broadly conic.
          - Basal cords 4 .... *trachis*, p. 148.
          - Basal cords 5.
            - Shell large, adult 4.0 mm. long .... *lucca*, p. 148.
            - Shell small, adult 2.3 mm. long .... *clementina*, p. 149.
          - Basal cords 6.
            - Outer lip of adult shell decidedly pinched in .... *oonisca*, p. 150.
            - Outer lip of adult shell not pinched in.
              - Whorls slopingly shouldered .... *oldroydi*, p. 150.
              - Whorls not shouldered.
                - Axial ribs decidedly retractive .... *nodosa*, p. 151.
                  - Nodules round .... *ovata*, p. 152.
                  - Nodules oval .... *cincta*, p. 152.
          - Basal cords 7.
            - Base of the last whorl strongly inflated .... *loomisi*, p. 153.
            - Base of the last whorl somewhat excavated.
              - Spaces between the spiral cords mere impressed lines. *vicola*, p. 153.
              - Spaces between the spiral cords broad, deep channels. *astricta*, p. 154.
          - Basal cords 8 .... *cooperi*, p. 155.
          - Basal cords 9 .... *hipolitensis*, p. 155.
        - Spiral cords 5 between the sutures of the later whorls. *lapazana*, p. 156.
        - Spiral cords 6 between the sutures of the later whorls. *proxima*, p. 157.

- All spiral cords between the sutures nodulose—Continued.
  - Sutures not channeled.
    - Axial ribs always stronger than the spiral cords .... *tyleri*, p. 157.
    - Axial ribs not as strong as the spiral cords.
      - Spiral cords 4 between the sutures.
        - Adult shell more than 5 mm. long .... *scammonensis*, p. 158.
        - Adult shell 3 or less mm. long.
          - Basal cords 4 .... *pulchra*, p. 158.
          - Basal cords 6.
            - Spaces between the spiral cords deep, broad channels. *montereyensis*, p. 159.
            - Spaces between the spiral cords mere impressed lines. *pulcia*, p. 160.
          - Basal cords 10 or more .... *virginalis*, p. 160.
      - Spiral cords 5 between the sutures .... *defolinia*, p. 161.
      - Spiral cords more than 5 between the sutures.
        - Basal cords 6 .... *oregonensis*, p. 162.
        - Basal cords 10 or more .... *virginalis*, p. 160.
- All spiral cords between the sutures not nodulose.
  - Anterior spiral cord between the sutures smooth and wholly exposed, the rest nodulose.
    - Nodulous spiral cords 4 between the sutures.
      - Shell large, adult more than 4.5 mm. long .... *benthina*, p. 163.
      - Shell small, adult less than 3 mm. long .... *promeces*, p. 164.
    - Nodulose spiral cords 3 between the sutures.
      - Shell large, adult 5 mm. long .... *pulcherrima*, p. 164.
      - Shell small, adult less than 3 mm. long.
        - Basal cords 5 .... *vincta*, p. 165.
        - Basal cords 6 .... *fasciata*, p. 165.
  - Anterior half of the whorls between the sutures usually not nodulous, the rest strongly so .... *virginalis*, p. 160.
    - Early whorls and frequently only the posterior part of these nodulose.
      - Shell long, adult more than 4 mm. long .... *helga*, p. 166.
      - Shell small, adult less than 3 mm. long.
        - Base decidedly attenuated anteriorly .... *sanctorum*, p. 167.
        - Base not strongly attenuated.
          - Spiral cords 6 between the sutures .... *sapia*, p. 167.
          - Spiral cords less than 6 between the sutures.
            - Spiral cords very strong .... *rotundata*, p. 168.
            - Spiral cords almost obsolete .... *deceptrix*, p. 169.

ODOSTOMIA (CHRYSALLIDA) REIGENI Carpenter.

Plate 13, fig. 7.

Chrysallida reigeni CARPENTER, Cat. Mazatlan Shells, 1856, p. 422.

Shell elongate-ovate. Nuclear whorls smooth, deeply immersed in the first of the succeeding turns. Post-nuclear whorls flattened, strongly contracted at the sutures and well shouldered at the summit, marked by strong axial ribs of which 18 occur upon the first and 20 upon the second and penultimate turn. In addition to the axial ribs, the intercostal spaces, which equal the ribs in width, are marked by four slender spiral cords between the sutures, which pass up on the sides of the ribs but do not cross their summits. The spaces between the ribs and cords are well impressed, round pits. Sutures channeled. Periphery of the last whorl marked by a groove. Base well rounded, marked by five subequal and equally spaced spiral cords, the spaces between which are crossed by slender axial threads. Aperture pyriform, posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, provided with an oblique fold at the insertion; parietal wall covered with a thin callus.

Tablet 1979, Liverpool collection, British Museum, contains the type which was taken off *Spondylus* at Mazatlan, Mexico. It has four post-nuclear whorls and measures: Length 1.4 mm., diameter 0.7 mm.

ODOSTOMIA (CHRYSALLIDA) INCONSPICUA C. B. Adams.

Plate 14, fig. 3.

Cingula inconspicua C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., vol. 5, 1852, p. 405.

Shell ovoid, milk-white. Nuclear whorls deeply, obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects, which is smooth. Post-nuclear whorls very slightly rounded, ornamented by strong axial ribs, of which 18 occur upon the second and third and 20 upon the penultimate turn. In addition to the axial ribs the whorls are marked by four equal and equally spaced slender spiral cords, which are a little less strong than the ribs, and render the junction with these nodulous. Sutures channeled; periphery and base of the last whorl well rounded, the latter marked by six equal spiral cords, which are about as wide as the spaces that separate them. The impressed grooves are crossed by numerous slender axial threads. Aperture ovate; posterior angle obtuse; outer lip thin, pinched in in the middle; columella slender, moderately curved, slightly reflected, partly reënforced by the base. Parietal wall covered with a strong callus, which renders the peritreme complete.

The type is at Amherst College, and was collected by Prof. C. B. Adams at Panama Bay. It has five post-nuclear whorls and measures: Length 1.5 mm., diameter 0.6 mm.

ODOSTOMIA (CHRYSALLIDA) TELESCOPIUM Carpenter.

Plate 13, fig. 9.

Chrysallida telescopium CARPENTER, Cat. Mazatlan Shells, 1856, pp. 421, 422.

Shell very elongate-conic, white. Nuclear whorls two, forming a moderately elevated helicoid spire which is about one-half obliquely immersed in the first of the succeeding turns. Post-nuclear whorls almost flattened, strongly contracted at the suture and strongly shouldered at the summit, marked by strong, vertical, axial ribs, of which 18 occur upon the first, 22 upon the second, 20 upon the third, 22 upon the fourth and penultimate turn. In addition to the axial ribs the whorls are marked by four slender, spiral cords which do not render the ribs tuberculate. The spaces between the cords and the ribs are deep round pits. Sutures channeled. Periphery of the last whorl marked by a groove. Base somewhat attenuated anteriorly, well rounded posteriorly, marked by seven spiral cords which become somewhat diminished in size from the periphery to the umbilical region. Grooves separating the cords marked by numerous slender axial threads. Aperture irregularly pyriform, effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella moderately stout, reflected, reënforced by the base, provided with a fold at its insertion; parietal wall covered with a thin callus.

Ten specimens (mostly young) off *Chama* and *Spondylus*, Liverpool collection, British Museum, were taken at Mazatlan, Mexico. Tablet 1978 contains three specimens, the largest of which has six post-nuclear whorls and measures: Length 3.1 mm., diameter 0.9 mm.

ODOSTOMIA (CHRYSALLIDA) EXCELSA, new species.

Plate 14, fig. 11.

Shell broadly conic, white. Nuclear whorls smooth, almost completely obliquely immersed in the first of the succeeding turns, above which the tilted edge of the last whorl only projects. Post-nuclear whorls flattened, strongly contracted at the sutures and somewhat shouldered at the summit, marked by strong protractive axial ribs, of which 16 occur upon the second, 18 upon the third, and 20 upon the remaining turns. In addition to the axial ribs the whorls are marked by four slender spiral cords between the sutures, which render the ribs tuberculate at their junction, the spaces inclosed by the ribs and spiral cords are deep, quadrangular pits, the long axis of which coincides with the spiral cords. Periphery of the last whorl marked by a strong sulcus which is crossed by the continuation of the axial ribs. Base of the last whorl attenuated, well rounded, marked by eight subequal and subequally spaced low spiral cords, the grooves between which are crossed by many slender axial threads. The summit of the last whorl falls below the first basal keel and leaves this in the suture. On the last half of the last turn, an additional slender spiral thread divides the space between the first and second and second and third strong spiral cords. Aperture pyriform, somewhat effuse anteriorly; posterior angle obtuse; outer lip (fractured), thin, showing the external sculpture within; columella strong, curved, decidedly reflected over the reënforcing base, provided with a strong fold at its insertion; parietal wall covered with a strong callus which renders the peritreme complete.

The type (Cat. no. 206894, U.S.N.M.) comes from the Bay of Panama. It has seven post-nuclear whorls and measures: Length 3.3 mm., diameter 1.3 mm.

ODOSTOMIA (CHRYSALLIDA) ACRYBIA, new species.

Plate 14, fig. 6.

Shell elongate-conic, milk-white. (Nuclear whorls decollated.) Post-nuclear whorls very slightly rounded, somewhat contracted at the sutures, feebly shouldered at the summits, marked by strong, almost vertical axial ribs, of which 14 occur upon the second, 16 upon the third, 18 upon the fourth, 20 upon the fifth, and 22 upon the penultimate turn. Intercostal spaces a little wider than the ribs, crossed by four slender spiral cords, the junction of which with the ribs renders them feebly nodulous. Sutures strongly impressed but not channeled. Periphery and base of the last whorl well rounded, the latter marked by nine slender spiral cords, the spaces between which are crossed by fine axial threads. Aperture oval, slightly effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella twisted, decidedly reflected anteriorly, provided with a strong fold at its insertion; parietal wall covered with a thick callus.

The type (Cat. no. 206895, U.S.N.M.) comes from Point Abreojos, Lower California. It has seven post-nuclear whorls and measures: Length 3.2 mm., diameter 1.2 mm. Another specimen from the same locality is in Mr. Hemphill's collection.

ODOSTOMIA (CHRYSALLIDA) COMMUNIS C. B. Adams.

Plate 14, figs. 10, 10*a*.

Chemnitzia communis C. B. Adams, Ann. Lyc. Nat. Hist. of N. Y., vol. 5, 1852, p. 390.

Shell conic, vitreous to milk-white. Nuclear whorls at least two, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-half immersed. Post-nuclear whorls flattened, strongly contracted at the suture and decidedly shouldered at the summit, marked by strong vertical axial ribs of which there are 16 upon the first and second, 18 upon the third to fifth, and 20 upon the penultimate turn. In addition to the ribs the whorls are marked by four spiral cords about one-half as strong as the ribs, between the sutures; the first of these is at the angle of the shoulder. The junction of the spiral cords and ribs nodulous; the spaces inclosed between them rectangular pits. Sutures channeled. Periphery of the last whorl marked by a spiral cord at whose posterior margin the axial ribs terminate. Base produced, moderately rounded, marked by ten spiral cords, which, like the grooves separating them, decrease regularly in size from the periphery to the umbilical area. The grooves on the base are crossed by numerous slender axial threads. Aperture pyriform, somewhat effuse anteriorly; channeled at the posterior angle, which is obtuse; outer lip thin, decidedly arched in the middle, flattened on the side, showing the external sculpture within; columella stout, reflected very much anteriorly; provided with a strong fold at its insertion; parietal wall covered with a thick callus.

Professor Adams collected 90 specimens in the Bay of Panama, which he listed under this species; 28 of these are in the Amherst collection which belong to three species. We have taken the finest for our description and figure of *Odostomia* (*Chrysallida*) *communis*, of which there are 15 specimens. The specimen described and figured has seven post-nuclear whorls and measures: Length 3.2 mm., diameter 1.2 mm.

ODOSTOMIA (CHRYSALLIDA) TORRITA, new species.

Plate 14, fig. 2.

Chrysallida communis (C. B. ADAMS) CARPENTER, Cat. Mazatlan Shells, 1856, pp. 419, 420; not *Chemnitzia communis* C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., vol. 5, 1852, p. 390=*Odostomia* (*Chrysallida*) *communis* [C. B. ADAMS].

Shell small, very elongate-ovate, vitreous. Nuclear whorls smooth, deeply obliquely immersed in the first of the succeeding turns, above which the tilted edge of the last volution only projects. Post-nuclear whorls slightly rounded, moderately contracted at the periphery and well shouldered at the summit, marked by strong axial ribs, of which about 20 occur upon all the whorls. Intercostal spaces about as wide as the ribs, marked between the sutures by four slender spiral cords which pass up on the sides of the ribs but do not cross their summits. On the last whorl the first basal keel falls between the sutures; here, too, the ribs are rendered slightly tuberculate by the spiral cords. Sutures strongly marked but not channeled. Periphery of the last whorl marked by a groove. Base somewhat produced, marked by twelve slender, spiral cords which are a little wider than the spaces that separate them and become successively narrower and more closely spaced from the periphery to the umbilical area. The spaces between the cords are marked by numerous slender, axial threads. Aperture pyriform, slightly effuse anteriorly; posterior angle acute; outer lip pinched in posteriorly; thin, showing the external sculpture within; columella stout, strongly reflected anteriorly, reënforced by the base, provided with a weak fold at its insertion; parietal wall covered with a strong callus.

The type and four specimens are part of the 500 specimens of this species found on *Chama* and *Spondylus* at Mazatlan, Mexico.

The type has five and one-half post-nuclear whorls and measures: Length 2 mm., diameter 0.8 mm.

ODOSTOMIA (CHRYSALLIDA) LICINA, new species.

Plate 14, fig. 9.

Shell pupiform, vitreous. Nuclear whorls large, obliquely immersed in the first of the succeeding turns, above which the tilted edge of the last volution only projects. Post-nuclear whorls flattened, slightly excurved at the shouldered summit, strongly contracted at the sutures, marked by very strong, vertical axial ribs, of which 16 occur upon all the whorls. In addition to these ribs, the whorls are marked between the sutures by four moderately strong spiral cords, which render the junction with the ribs obscurely nodulous. The spaces inclosed between the ribs and cords are well impressed squarish pits. Sutures strongly impressed. Periphery and base of the last whorl well rounded, marked by the feeble continuations of the axial ribs and twelve slender spiral cords which grow successively weaker from the periphery to the umbilical area. Aperture elongate, oval; posterior angle obtuse, outer lip thin, showing the external sculpture within; columella slender, decidedly curved, slightly reflected, reënforced by the base, provided with a weak fold at its insertion; parietal wall covered with a thin callus.

The type and another specimen (Cat. no. 106500, U.S.N.M.) were collected at Manuel Lagoon, Lower California. The type has six post-nuclear whorls and measures: Length 3 mm., diameter 1.2 mm.

ODOSTOMIA (CHRYSALLIDA) TALAMA, new species.

Plate 18, fig. 6.

Shell conic, vitreous. Nuclear whorls small, smooth, obliquely deeply immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls flattened, strongly contracted at the periphery and moderately shouldered at the summit, marked by moderately strong, almost vertical, axial ribs, of which 16 occur upon the second and third, 18 upon the fourth, 20 upon the fifth, and 22 upon the penultimate turn. In addition to the axial ribs, the whorls are marked by four slender spiral cords between the sutures, the junction of which, with the axial ribs, renders them feebly nodulous. The spaces inclosed by the ribs and cords are well impressed squarish pits. Sutures strongly channeled. Periphery marked by a slender spiral cord, on the posterior edge of which the axial ribs terminate. Base of the last whorl well rounded, slightly attenuated anteriorly, marked by twelve spiral cords which grow successively weaker from the periphery to the umbilical area. Aperture oval, posterior angle acute, outer lip thin, showing the external sculpture within, rendered sinuous by the spiral cords; columella slender, slightly reflected and reënforced by the base; provided with a slender fold at its insertion.

The type and three specimens (Cat. no. 106518, U.S.N.M.) come from Scammon Lagoon, Lower California. The type has six post-nuclear whorls and measures: Length 3.4 mm., diameter 1.3 mm.

ODOSTOMIA (CHRYSALLIDA) EFFUSA Carpenter.

Plate 14, figs. 5, 5*a*.

Chrysallida effusa CARPENTER, Cat. Mazatlan Shells, 1856, p. 422.

Shell elongate-conic, vitreous. Nuclear whorls small, smooth, almost completely obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls flattened, strongly contracted at the sutures and moderately shouldered at the summit, marked by strong, tuberculate retractive axial ribs, of which 18 occur upon the first and second and 20 upon the remaining turns. In addition to these axial ribs the whorls are marked by four slender, spiral cords between the sutures, which pass over the axial ribs and render them tuberculate at their junction. The spaces inclosed by the ribs and cords are rectangular pits, which have their long axis parallel with the spiral cords. Sutures channeled. Periphery of the last whorl marked by a spiral groove. Base of the last whorl well rounded, marked by eight spiral cords which grow successively weaker and closer spaced from the periphery to the umbilical area. The wide grooves between the spiral cords are marked by slender, raised, axial threads, which correspond to the ribs on the spire. Aperture ovate, somewhat effuse anteriorly; posterior angle obtuse, outer lip thin, showing the external markings within; columella stout, strongly reflected, provided with a slender fold at its insertion; parietal wall covered by a strong callus.

The type, which is on tablet 1980, Liverpool collection, British Museum, came off *Chama* at Mazatlan, Mexico. The specimen described and figured (no. 16194, U.S.N.M.) was collected by J. Xantus, at Cape St. Lucas, Lower California. It has six post-nuclear whorls and measures: Length 2.8 mm., diameter 1.2 mm.

ODOSTOMIA (CHRYSALLIDA) PAUPERCULA C. B. Adams.

Plate 14, fig. 4.

Cingula (*?*) *paupercula* C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., vol. 5, 1852, pp. 405, 406.

Shell very elongate, conic, bluish-white. Nuclear whorls two, smooth, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about half immersed. Post-nuclear whorls moderately rounded, slightly shouldered at the summit, somewhat contracted at the sutures, marked by four strong spiral cords and axial ribs, which are a little less strong than the cords; 18 of the ribs occur upon the first, 16 upon the second to fifth, 20 upon the sixth, and 34 upon the penultimate turn. The junctions of the ribs and spiral cords form moderately strong tubercles, while the spaces inclosed between them appear as almost circular, well-impressed pits. Periphery of the last whorl marked by a spiral keel a little less strong than those between the sutures. Base well rounded, somewhat attenuated anteriorly; marked by five almost equal and equally spaced spiral cords and two very slender lirations, the latter near the columella. The deep grooves between the spiral cords are marked by numerous slender axial lirations. Sutures subchanneled. Aperture irregular, somewhat channeled anteriorly. Posterior angle obtuse, outer lip thin, rendered sinuous by the spiral cords. Columella slender, sigmoid, reënforced by the base, provided with a strong, deep-seated fold at its insertion. Parietal wall covered with a faint callus.

Prof. C. B. Adams's type is at Amherst College, and was collected in the Bay of Panama. It has eight post-nuclear whorls and measures: Length 3.3 mm., diameter 0.9 mm.

ODOSTOMIA (CHRYSALLIDA) CLATHRATULA C. B. Adams.

Plate 14, figs. 7, 7*a*.

Chemnitzia clathratula C. B. Adams, Ann. Lyc. Nat. Hist. N. Y., vol. 5, 1852, pp. 389, 390.

Shell elongate-conic, slender, vitreous. Nuclear whorls two and one-half, forming a depressed helicoid spire, whose axis is almost at right angles to that of the succeeding turns, in the first of which it is about one-half immersed. Post-nuclear whorls very slightly rounded, strongly constricted at the sutures and prominently shouldered at the summit, marked by well rounded, tuberculate, axial ribs, of which 14 occur upon the first and second, 16 upon the third, 18 upon the fourth and fifth, and 24 upon the penultimate turn. In addition to the axial ribs, the whorls are marked between the sutures by four spiral cords which equal the ribs in strength, and render them tuberculate at their junction. Sutures broadly and deeply channeled. Periphery and the somewhat prolonged base of the last whorl well rounded, the latter marked by seven narrow, almost equal, and equally spaced spiral keels, the broad space between which and the peripheral sulcus are marked by many slender axial riblets. Aperture oval; outer lip (fractured anteriorly) thin, showing the external sculpture within; columella stout, slightly curved, strongly reflected over the reënforcing base, provided with a strong fold at its insertion.

Professor Adams states that ten specimens in various stages of growth were collected in the sand of the Bay of Panama; two of these are in the collection at Amherst College.

We have figured the better of the two individuals which has seven post-nuclear whorls and measures: Length 2.8 mm., diameter 0.9 mm.

ODOSTOMIA (CHRYSALLIDA) RITTERI, new species.

Plate 14, figs. 8, 8*a*.

Shell elongate-conic, milk-white. Nuclear whorls at least two, smooth, deeply obliquely immersed in the first of the succeeding turns, above which only a portion of the last two turns project. Post-nuclear whorls moderately rounded, strongly constricted at the sutures, slopingly shouldered at the summit, ornamented by strong, retractive axial ribs of which 14 occur upon the first, 16 upon the second to fourth, 18 upon the fifth, and 20 upon the penultimate turn. In addition to the axial ribs, the whorls are marked by spiral cords between the sutures, which are a little more than half as strong as the ribs and of which three occur upon the first three whorls and four upon the succeeding turns; the second one below the summit marking the angle of the long sloping shoulder. Junction of ribs and cords strongly nodulous; the spaces inclosed between them are deep squarish pits. Sutures strongly channeled. Periphery of the last whorl marked by a broad groove that is crossed by the continuations of the axial ribs which terminate at the posterior margin of the first basal keel. Base of the last whorl well rounded, marked by six spiral cords which are of unequal strength, separated by grooves of different widths, which are crossed by fine axial threads. Aperture oval, effuse anteriorly; posterior angle obtuse; outer lip rendered sinuous by the cords, thin, showing the external sculpture within; columella slender, strongly reflected, provided with a fold at its insertion.

The type (Cat. no. 206896, U.S.N.M.) was dredged at station 30, University of California, off Catalina Island. It has seven post-nuclear whorls and measures: Length 4.5 mm., diameter 1.6 mm. Four topotypes are in the collection of the University of California, which has the following additional specimens: Four from station 47, off San Diego; three from station 59; and two from station 83, also from off San Diego. Cat. no. 206897, U.S.N.M., one dredged in 50 fathoms, off Catalina Island.

Named for Prof. W. E. Ritter.

ODOSTOMIA (CHRYSALLIDA) RINELLA, new species.

Plate 15, figs. 6, 6*a*.

Shell elongate-ovate, cream-colored. Nuclear whorls at least two, smooth, forming a depressed helicoid spire, which is obliquely three-fifths immersed in the first of the succeeding turns. Post-nuclear whorls moderately rounded, strongly contracted at the sutures, somewhat shouldered at the summits, marked by strong, tuberculated axial ribs and four spiral cords almost as strong as the ribs between the sutures which renders their junction with the ribs tuberculate. Of the ribs which are slightly protractive, 17 appear upon the first to third and 19 upon the penultimate whorl. Sutures strongly channeled. Periphery of the last whorl marked by a sulcus which is crossed by the continuation of the axial ribs. Base moderately long, well rounded, marked by six slender spiral threads, the axial sculpture being reduced to mere lines of growth. Aperture oval; posterior angle obtuse; outer lip thin; columella oblique, almost straight, decidedly revolute, marked with a strong fold at its insertion.

The type (Cat. no. 162781, U.S.N.M.) comes from the Bay of Panama. It has five post-nuclear whorls and measures: Length 2.3 mm., diameter 1.1 mm.

ODOSTOMIA (CHRYSALLIDA) EUGENA, new species.

Plate 14, figs. 1, *1a*.

Shell elongate-conic, milk-white. Nuclear whorls at least two, small, smooth, obliquely half immersed in the first of the succeeding turns. Post-nuclear whorls well rounded, moderately contracted at the suture, well shouldered at the summit, marked by strong, very retractive axial ribs, of which 14 occur upon the first, 16 upon the second, 18 upon the third to fifth, and 22 upon the penultimate whorl. In addition to these ribs the whorls are marked by four strong spiral cords between the sutures which render their junction with the ribs tuberculate. The spaces inclosed by the ribs and cords form oval pits, the long axis of which coincides with the spiral sculpture. Sutures channeled. Periphery of the last whorl marked by a moderately broad groove, which is crossed by the continuation of the axial ribs which terminate at the posterior edge of the first basal keel. Base of the last whorl well rounded, marked by six spiral keels which grow successively weaker from the periphery to the umbilical region. The broad spaces between these keels are crossed by slender, raised axial threads. Aperture oval; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella stout, curved, strongly reflected and reënforced by the base, provided with a strong fold at its insertion.

The type and three specimens (Cat. no.127545, U.S.N.M.) comes from San Hipolito Point, Lower California. The type has seven and one-half post-nuclear whorls and measures: Length 4.3 mm., diameter 1.5 mm. Cat. no. 168566, U.S.N.M., one specimen from San Pedro. Two specimens were identified from the same region for Mr. Berry. Cat. no. 168567, U.S.N.M, one specimen from San Diego. Another from the foot of Ash street, San Diego, was identified for Mrs. Oldroyd.

ODOSTOMIA (CHRYSALLIDA) TRACHIS, new species.

Plate 15, figs. 4, 4*a*.

Shell small, elongate-conic. Nuclear whorls small, smooth, strongly obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls moderately rounded, strongly contracted at the sutures, slopingly shouldered at the summit, marked by strong, rounded, decidedly retractive axial ribs, of which 16 occur upon the second, 18 upon the third, and 20 upon the penultimate turn. In addition to the axial ribs the whorls are crossed between the sutures by four spiral cords, which are as strong as the ribs and render them nodulous at their junction. The second of these cords below the summit marks the angle of the shoulder. The spaces inclosed by the ribs and cords are deep, squarish pits. Sutures subchanneled. Periphery of the last whorl marked by a groove, crossed by the spiral ribs, which terminate at the extremity of the first basal cord. Base well rounded, marked by four subequal, distantly spaced, narrow, spiral cords, the broad spaces between which are crossed by numerous axial threads. Aperture oval; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, reflected, reënforced by the base, provided with a fold at its insertion; parietal wall covered with a thin callus.

The type (Cat. no. 168619, U.S.N.M.) comes from San Pedro, California. It has five post-nuclear whorls and measures: Length 2.5 mm., diameter 1 mm.

ODOSTOMIA (CHRYSALLIDA) LUCCA, new species.

Plate 15, figs. 8, 8*a*.

Shell broadly conic, milk-white. Nuclear whorls large, obliquely immersed in the first of the succeeding turns, above which the tilted edge of the last volution only projects, which shows five strong spiral threads. Post-nuclear whorls well rounded, strongly contracted at the sutures, appressed at the summits with a sloping shoulder that extends from the summit to the second spiral keel, marked by narrow decidedly elevated, retractive axial ribs, of which 16 occur upon the first and second, 18 upon the third, and 22 upon the penultimate turn. In addition to the ribs, the whorls are marked between the sutures by four spiral keels, which equal the ribs in strength and render them decidedly nodulous at their junction. The spaces inclosed by the ribs and cords are well impressed rectangular pits whose axis coincides with the spiral sculpture. Sutures subchanneled, showing a portion of the first basal keel in the last two volutions. Periphery of the last whorl marked by a broad channel, crossed by the axial ribs which terminate at the posterior edge of the first basal keel. Base of the last whorl well rounded, marked by five subequal and subequally spaced spiral lirations, separated by broad spaces which are marked by numerous prominent axial threads. Aperture broadly oval; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella moderately strong, curved, reënforced by the base, provided with a weak fold at its insertion; parietal wall covered with a thin callus.

The type (Cat. no. 206898, U.S.N.M.) comes from San Diego. It has five post-nuclear whorls and measures: Length 4 mm., diameter 1.4 mm. The University of California has one specimen from station 30, off Santa Catalina Island, and four from station 47, off San Diego.

This species is closely allied to *Odostomia* (*Chrysallida*) *oldroydi.* It differs in having a comparatively larger nucleus which is more prominently sculptured, in being more attenuated and having more slender ribs and spiral cords and in having the axial sculpture on the base much stronger. It is likewise much smaller.

ODOSTOMIA (CHRYSALLIDA) CLEMENTINA, new species.

Plate 15, figs. 5, 5*a*.

Shell elongate-conic, vitreous. Nuclear whorls obliquely immersed in the first post-nuclear turn, above which only the tilted edge of the last volution projects, which is marked by five slender spiral threads. Post-nuclear whorls well rounded, moderately contracted at the sutures, strongly slopingly shouldered at the summit, marked by strong, somewhat retractive axial ribs, of which 14 occur upon the first and second, 18 upon the third and the penultimate turn. In addition to the axial ribs, the whorls are marked by four spiral cords between the sutures, of which the second one anterior to the summit marks the angle of the shoulder. On the last two whorls the first basal is apparent in the strongly contracted sutures. Periphery of the last whorl marked by a spiral groove. Base well rounded, somewhat attenuated anteriorly, marked by five distant spiral cords which grow successively weaker from the periphery to the umbilical region. The broad spaces that separate these cords are marked by numerous fine, raised, axial threads. Aperture broadly oval; posterior angle obtuse; outer lip thin, showing the external sculpture within, rendered sinuous by the spiral cords; columella moderately strong, slightly reflected, reënforced by the base, provided with a slender fold at its insertion.

The type (Cat. no. 162043, U.S.N.M.) comes from San Clemente Island, California. It has five post-nuclear whorls and measures: Length 2.3 mm., diameter 1.1 mm.

ODOSTOMIA (CHRYSALLIDA) OONISCA, new name.

Plate 15, fig. 3.

Chrysallida ovulum CARPENTER, Cat. Maz. Shells, 1856, pp. 423, 424; not *Pasithea* (=*Odostomia*) *ovulum* LEA, 1845.

Shell ovate, white. Nuclear whorls deeply obliquely immersed in the first post-nuclear whorl above which only the tilted edge of the last volution projects. Post-nuclear whorls moderately rounded, strongly contracted at the sutures, moderately shouldered at the summit, marked by the moderately strong, tuberculate, slightly retractive axial ribs, of which 16 occur upon the second and 18 upon the third and penultimate turn. In addition to the axial ribs the whorls are marked by four spiral cords between the sutures which are a little less strong than the axial ribs and render them nodulous at their junction. The spaces inclosed by the ribs and spiral cords are deep round pits. Sutures channeled. Periphery of the last whorl marked by a groove. Base well rounded, marked by six strong, spiral cords which decrease successively in size and spacing from the periphery to the umbilicus. Grooves between the spiral cords marked by slender threads corresponding to the axial ribs. Aperture irregularly pyriform, posterior angle acute; outer lip pinched in posteriorly, thin, showing the external sculpture within; columella slender, slightly reflected, provided with a fold at its insertion; parietal wall covered with a thin callus.

Tablet 1982, Liverpool collection, British Museum, contains nine specimens taken from *Spondylus* and *Chama* at Mazatlan, Mexico. A specimen of four whorls measures: Length 1.4 mm., diameter 0.7 mm.

ODOSTOMIA (CHRYSALLIDA) OLDROYDI, new species.

Plate 15, figs. 1, 1*a*.

Shell elongate-ovate, vitreous. Nuclear whorls small, obliquely immersed in the first of the succeeding turns, above which projects the tilted edge which is marked with five raised spiral lirations. Post-nuclear whorls somewhat inflated, well rounded, moderately contracted at the sutures, strongly slopingly shouldered at the summit, ornamented with somewhat retractive axial ribs, of which 14 occur upon the first, 16 upon the second, 18 upon the third, and 20 upon the penultimate turn. In addition to the axial ribs, the whorls are marked by four spiral cords between the sutures which are as strong as the ribs and render them strongly nodulous at their junction. The second of these ribs below the summit marks the angle of the shoulder. The spaces inclosed by the ribs and cords are strongly impressed oblong pits, the long axis of which coincides with the spiral sculpture. Sutures strongly constricted. Periphery of the last whorl marked by a spiral groove, crossed by the continuations of the axial ribs, which terminate at the posterior edge of the first basal keel. Base well rounded posteriorly, somewhat attenuated anteriorly, marked by six almost equal spiral keels, which are less developed about the umbilical area. The deep grooves between these keels are crossed by numerous very slender, raised axial threads. Aperture oval; posterior angle obtuse; outer lip thin, showing the external sculpture within; rendered decidedly sinuous by the spiral cords; columella moderately strong, decidedly reflected anteriorly, provided with a fold at its insertion.

The type (Cat. no. 162765, U.S.N.M.) comes from San Diego, California. It has five post-nuclear whorls and measures: Length 3.5 mm., diameter 1.7 mm. Cat. no. 162766, U.S.N.M., one specimen from Whites Point, San Pedro. Cat. no. 168569, U.S.N.M., one specimen from U. S. Bureau of Fisheries station 2932, in 20 fathoms, temperature 58°, off Los Coronados Islands.

Named for Mrs. T. S. Oldroyd.

ODOSTOMIA (CHRYSALLIDA) NODOSA Carpenter.

Plate 15, figs. 9, 9*a*.

Chrysallida nodosa CARPENTER, Cat. Mazatlan Shells, 1856, pp. 417, 418.

Shell very elongate-ovate, white. Nuclear whorls small, deeply obliquely immersed in the first of the succeeding turns. Post-nuclear whorls moderately rounded, considerably contracted at the sutures and moderately shouldered at the summit, marked by strongly nodulous, decidedly retractive axial ribs, of which 14 occur upon the first, 16 upon the second to fourth, and 22 upon the penultimate turn. In addition to the axial ribs the whorls are marked between the sutures by four spiral keels which are a little less strong than the ribs and render them nodulous at their junction. The spaces inclosed between the ribs and spiral cords are oblong oval pits on all the whorls but the last on which they are round. Sutures subchanneled. Periphery of the last whorl marked by a strong broad groove, is curved by the axial ribs which extend to the posterior border of the first basal cord. Base of the last whorl well rounded, marked by six strong rounded, spiral cords which are a little weaker at the umbilical area than at the periphery. Spaces separating the spiral cords of the base about as wide as the cords, covered by numerous slender axial threads. Aperture oval; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, curved, provided with a strong fold at its insertion; parietal wall covered with a thin callus.

Five specimens of this species were taken off *Spondylus* at Mazatlan, Mexico. Tablet 1969, Liverpool collection, British Museum, contains two specimens; one of these has six post-nuclear whorls and measures: Length 4.1 mm., diameter 1.8 mm.

ODOSTOMIA (CHRYSALLIDA) OVATA Carpenter.

Plate 15, figs. 7, 7*a*.

Chrysallida ovata CARPENTER, Cat. Mazatlan Shells, 1856, p. 417.

Shell ovate, white. Nuclear whorls obliquely immersed in the first of the succeeding turns above which only the tilted edge of the last volution projects. Post-nuclear whorls slightly rounded, well contracted at the sutures, and moderately shouldered at the summit, marked by nodulose slightly retractive axial ribs of which 20 occur upon the first to second, 18 upon the third, and 22 upon the penultimate turn. In addition to the ribs the whorls are marked between the sutures by four spiral cords considerably less strong than the ribs, which render them nodulous at their junction. The spaces inclosed by the ribs and spiral cords are deep round pits. Sutures well marked but not channeled. Periphery of the last whorl marked by a narrow spiral groove. Base well rounded, marked by six strong broad rounded almost equal and equally spaced spiral cords, the grooved spaces between which are marked by numerous fine axial threads. Aperture oval, slightly effuse anteriorly; posterior angle acute; outer lip rendered slightly sinuous by the spiral cords; columella slender and curved, provided with a fold, deep within, at its insertion; parietal wall covered by a thin callus.

Three specimens of this species taken from *Spondylus* at Mazatlan, Mexico, are on tablet 1968, Liverpool collection, British Museum. One of these has five whorls and measures: Length 3.9 mm., diameter 2.1 mm.

ODOSTOMIA (CHRYSALLIDA) CINCTA Carpenter.

Plate 15, figs. 2, 2*a*.

Chrysallida cincta CARPENTER, Rep't Brit. Assn. Adv. Sci., 1864, p. 659.

Shell elongate-ovate, vitreous. Nuclear whorls smooth, deeply immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, marked by vertical axial ribs which are strongest near the summit, becoming much enfeebled as they pass to the suture. Of these ribs 18 occur upon the second and third and 20 upon the fourth whorl. In addition to the ribs the whorls are marked by four broad, strong, spiral keels which form nodules at their junction with the ribs. On the last whorl the axial sculpture is obsolete on the anterior half between the sutures. Sutures subchanneled. Periphery of the last whorl marked by a strong keel. Base well rounded posteriorly, effuse anteriorly, marked by six low, spiral cords, the two nearest the umbilical area being very faint. Aperture oval, decidedly effuse anteriorly; posterior angle acute; outer lip rendered sinuous by the spiral cords, thin, showing the external sculpture within; columella slender, very long, almost straight, reflected, reënforced by the base, provided with a weak fold at its insertion.

The type (Cat. no. 15730, U.S.N.M.) was collected by Cooper at Santa Barbara, California. It has five post-nuclear whorls and measures: Length 3 mm., diameter 1.5 mm. Cat. no. 162768, U.S.N.M., contains another specimen from San Pedro. Cat. no. 162769, U.S.N.M., one specimen from Pacific Beach, California.

ODOSTOMIA (CHRYSALLIDA) LOOMISI, new species.

Plate 16, fig. 3.

Shell very small, pupiform, vitreous. Nuclear whorls smooth, deeply obliquely immersed in the first of the succeeding turns, above which only a portion of the tilted edge of the last volution projects. Early post-nuclear whorls well rounded, later ones flattened, somewhat excurved at the shouldered and beaded summit, and slightly contracted at the sutures, marked by strong rounded, tuberculated axial ribs, which are decidedly protractive on all but the last whorl; on this they are only moderately protracted. Of the axial ribs, 14 appear upon the first, 16 upon the second, 20 upon the third, and 24 upon the penultimate turn. In addition to the ribs the whorls are marked between the sutures by four spiral cords, which almost equal the ribs in strength, forming tubercles at their junctions with the axial ribs. On the last whorl and one-half the summit drops below the peripheral keel and leaves this in the suture; the axial ribs, however, terminate at the posterior edge of it, and thus leave it without tubercles. The spaces inclosed by the ribs and cords appear as deep oval pits having their long axis parallel to the cords. Sutures well marked but not channeled. Base of the last whorl long, well rounded, marked by seven spiral cords, the four anterior to the periphery being equal and equally spaced, the other three growing successively smaller; channels between the cords very regular, marked by many slender axial riblets. Aperture oval, somewhat effuse anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, curved, and reflected, not reënforced by the base.

The type and five specimens were with Prof. C. B. Adams's type of *Chemnitzia communis* at Amherst College. They come from the Bay of Panama. The type has five post-nuclear whorls and measures: Length 2 mm., diameter 0.9 mm.

Named for Prof. F. B. Loomis.

ODOSTOMIA (CHRYSALLIDA) VICOLA, new species.

Plate 16, fig. 11.

Shell ovate, vitreous. Nuclear whorls large, deeply immersed in the first of the succeeding turns, above which the tilted edge of the last volution only projects, which is marked by five slender spiral threads. Post-nuclear whorls rounded on all but the first whorl, marked by very broad, strong, retractive axial ribs, of which 16 occur upon the second and third and 20 upon the penultimate turn. In addition to the axial ribs the whorls are marked by four very broad, low spiral cords, which are separated by mere incised lines between the sutures, which render their junction with the axial ribs very strongly nodulous. Sutures constricted, showing a portion of the peripheral cord. Periphery of the last whorl marked by a strong, well rounded spiral cord. Base of the last whorl decidedly attenuated, marked by seven subequal spiral cords, the spaces between which are marked by numerous slender, axial threads. Aperture elongate-ovate, decidedly effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within, rendered sinuous by the spiral cords; columella long, moderately strong, somewhat sinuous, reflected, reënforced by the base, and provided with a fold at its insertion.

The type (Cat. no. 206899, U.S.N.M.) comes from San Pedro Bay, California. It has five post-nuclear whorls and measures: Length 2.5 mm., diameter 1.2 mm.

ODOSTOMIA (CHRYSALLIDA) ASTRICTA Dall and Bartsch.

Plate 16, fig. 2.

Odostomia (*Chrysallida*) *astricta*, DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 515, pl. 46, fig. 1.

Shell elongate-conic, bluish-white. Nuclear whorls decollated. Post-nuclear whorls very slightly rounded, separated by deeply channeled sutures. In this species the axial ribs exceed the four spiral keels in strength, their junction forming elongated tubercles the long axis of which coincides with the spiral keels. The axial ribs, of which there are 16 upon all of the turns, slant decidedly backward near the aperture. They are rather distantly spaced and the spaces inclosed between them and the spiral keels are deep oblong pits, the long axis of which coincides with the spiral sculpture. Periphery of the last whorl marked by a deep, wide channel across which the ribs extend feebly to the first subperipheral keel. Base rather long and well rounded, marked by seven rather narrow, slender spiral keels which successively decrease in strength from the periphery to the umbilical area, the anterior ones being only faintly indicated; the spaces which separate the keels are about twice as wide as the keels and are crossed by many very slender raised axial threads. Aperture oval, outer lip rather thick, columella twisted, reënforced by the attenuated base and provided with a moderately strong fold at its insertion; parietal wall covered by a strong callus.

The type (Cat. no. 196280, U.S.N.M.) was collected by Mr. F. L. Button at Monterey, California; it has the six last whorls remaining, having lost the nucleus and probably the first post-nuclear turn, and measures: Length 2.9 mm., diameter 1.2 mm.

ODOSTOMIA (CHRYSALLIDA) COOPERI Dall and Bartsch.

Plate 16, fig. 4.

Odostomia (*Chrysallida*) *cooperi* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 514, 515, pl. 46, fig. 7.

Shell broadly conic, white. Nuclear whorls smooth, largely obliquely immersed in the first of the succeeding turns above which only about half of the last turn projects. Post-nuclear whorl moderately rounded, slopingly shouldered at the summit, the shoulder bearing the first of the four stronger tuberculate spiral ridges. The connections which join the tubercles in the spiral series are a little more strongly developed than those which link them vertically, the spaces inclosed between them being deep squarish pits. The tubercles are very prominent and rounded; there are about 16 upon the second, 20 upon the third, and 26 upon the penultimate turn. The axial series slants retractively from the posterior suture. Sutures deep and broad, considerably wider than the spaces between the keels. Periphery of the last whorl deeply channeled, the channel marked by a weak extension of the axial bars which terminate at the first supra-peripheral keel. Base prolonged, well-rounded, marked by seven strong moderately raised spiral keels which, like the channels that separate them, diminish regularly in width from the periphery to the umbilical area; the last, the eighth, immediately behind the columella, being less distinct and considerably broader than the rest. The channels between the keels are about equal to the keels in width and are crossed by numerous very slender raised threads, which extend up on the sides of the keels but do not cross them. About five of these threads fall in the space between two tubercles on the spire, in the first supra-peripheral groove. Aperture oval, large, effuse anteriorly, posterior angle obtuse, outer lip rather thick, not showing the external sculpture within; columella somewhat twisted, revolute anteriorly, reënforced by the attenuated base, and provided with a weak fold at its insertion; parietal wall covered by a callus which joins the columella with the posterior angle of the aperture and renders the peristome almost complete.

The type (Cat. no. 162771, U.S.N.M.) was collected by Doctor Dall at Monterey, California. It has five post-nuclear whorls and measures: Length 3.1 mm., diameter, 1.4 mm.

ODOSTOMIA (CHRYSALLIDA) HIPOLITENSIS, new species.

Plate 16, fig. 8.

Shell very elongate-ovate, bluish-white. Nuclear whorls deeply obliquely impressed in the first of the succeeding turns. Post-nuclear whorls well rounded, marked by four strong spiral cords between the sutures, which are separated by narrow, deeply incised channels. In addition to these spiral cords the whorls are marked by weak axial ribs which extend only feebly to the first supra-peripheral cord, rendering the junction with the cords feebly nodulous. Sutures strongly constricted, not channeled. Periphery of the last whorl marked by a spiral cord. Base well rounded, slightly channeled anteriorly, marked by nine spiral cords which become successively weaker and closer spaced from the periphery to the umbilical area. The spaces between the cords are marked by numerous slender axial threads. Aperture oval, effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella moderately strong, twisted, strongly reflected, reënforced by the base, provided with a strong fold at its insertion.

The type (Cat. no. 162770, U.S.N.M.) comes from San Hipolito Point, Lower California. It has five post-nuclear whorls and measures: Length 3.5 mm., diameter 1.7 mm.

ODOSTOMIA (CHRYSALLIDA) LAPAZANA, new species.

Plate 16, figs. 9, 9*a*.

Shell broadly ovate, white. Nuclear whorls smooth, deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls moderately contracted at the sutures, strongly slopingly shouldered at the summit, where the angle of the shoulder falls on the second spiral keel. The whorls are marked by well developed, nodulous axial ribs, of which 20 occur upon all the whorls. Intercostal spaces about twice as wide as the ribs, crossed by five equal spiral cords, which are about half as strong as the ribs and render them nodulous at their junction. The first spiral cord is a little posterior to the middle of the shoulder. The spaces inclosed by the ribs and cords are deep, rectangular pits, the long axis of which coincides with the spiral cords. Sutures strongly marked, but not channeled. Periphery of the last whorl marked by a spiral cord to the posterior extremity of which the axial ribs extend, but whose summits they do not cross. Base short, well rounded, marked by nine spiral keels which are about as wide as the spaces that separate them, decreasing successively in strength and spacing from the periphery to the umbilical area. The grooves between the spiral cords are marked by numerous fine, axial raised threads. Aperture oval, slightly effuse anteriorly; posterior angle obtuse; outer lip thin; columella slender, strongly reflected, provided with a fold at its insertion.

The type (Cat. no. 162778, U.S.N.M.) and two specimens were dredged at U. S. Bureau of Fisheries station 2823, in 26.5 fathoms, off La Paz, Lower California. The type has five post-nuclear whorls and measures: Length 2.8 mm., diameter 2.1 mm.

ODOSTOMIA (CHRYSALLIDA) PROXIMA de Folin.

Plate 16, fig. 7.

Noemia proxima DE FOLIN, Fonds de la Mer, vol. 2, 1872, pp. 166, 167, pl. 6, fig. 3.

Shell ovate, conic, crystalline. Nuclear whorls one and one-half, obliquely immersed in the first of the succeeding turns. Post-nuclear whorls strongly constricted at the sutures, moderately shouldered at the summit, marked by strong vertical axial ribs, of which 20 occur upon the second and third and 22 upon the penultimate turn. These ribs disappear at the periphery. The spaces between the ribs are marked by spiral cords a little less strong than the ribs; four of these occur between the sutures on the second and third, and seven upon the penultimate turn. Their intersections with the ribs form nodules. Sutures channeled. Base somewhat attenuated, marked by eleven spiral cords, the spaces between which are axially lirate. Aperture subpyriform, posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, somewhat curved and reflected, provided with a strong fold at its insertion; parietal wall covered with a thin callus.

De Folin's type was collected at Margarita Island, Bay of Panama. It has four post-nuclear whorls and measures: Length 2.5 mm., diameter 1 mm.

ODOSTOMIA (CHRYSALLIDA) TYLERI, new species.

Plate 16, fig. 5.

Shell robust, subdiaphanous to milk-white. Nuclear whorls smooth, immersed in the first of the succeeding turns, above which only a part of the decidedly tilted edge of the last whorl projects. Post-nuclear whorls flattened, slightly excurved at the summit, scarcely at all contracted at the periphery and moderately shouldered at the summit, marked by very strong, rounded, axial ribs, of which 14 occur upon the first, 16 upon the second, 18 upon the third, 20 upon the fourth, 22 upon the fifth, and 24 upon the penultimate turn. In addition to the axial ribs the whorls are marked by spiral cords, less strong than the ribs, the junctions of which with the ribs render them tuberculate. Of these cords, four occur upon all the whorls but the penultimate and last, which have five between the sutures. The spaces inclosed between the ribs and cords are deep square pits. The posterior cord is on the summit of the whorl and is a little stronger than the rest, rendering the whorls, which are excurved, crenulated. Suture well marked but not channeled. Periphery and the somewhat attenuated base of the last whorl well rounded, marked by seven strong, rounded, spiral cords which diminish successively in size and spacing from the periphery to the umbilical area. The channels which separate the cords are marked by numerous fine axial riblets. Aperture irregularly pyriform, somewhat effuse anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella stout, twisted, curved, slightly reflected, reënforced by the base and provided with a strong fold at its insertion; parietal wall covered by a strong callus, which practically renders the peritreme complete.

The type and five specimens were Prof. C. B. Adams's type lot of *Chemnitzia communis* collected in the Bay of Panama. They are at Amherst College. The type has seven post-nuclear whorls and measures: Length 2.8 mm., diameter 1.2 mm.

Named for Prof. J. M. Tyler.

ODOSTOMIA (CHRYSALLIDA) SCAMMONENSIS, new species.

Plate 16, fig. 6, 6*a*.

Shell large, elongate-conic, white. Nuclear whorls smooth, deeply obliquely immersed in the first of the succeeding turns, above which only a portion of the last volution projects. Post-nuclear whorls very slightly rounded, moderately contracted at the sutures, slightly excurved at the shouldered summit, marked by strong, vertical axial ribs, of which 16 occur upon the second and third, 18 upon the fourth, 20 upon the fifth and sixth, and 26 upon the penultimate turn. Intercostal spaces about twice as wide as the ribs, crossed by five slender spiral cords between the sutures, which render the ribs feebly nodulous at their junction. Sutures strongly impressed. Periphery and base of the last whorl decidedly inflated, the latter narrowly umbilicated, marked by seven weak spiral cords. Aperture large, elongate-oval; outer lip thin, showing the external sculpture within; columella slender, curved, reflected, provided with a strong fold at its insertion.

The type (Cat. no. 106518*a*, U.S.N.M.) comes from Scammon Lagoon, Lower California. It has lost the nucleus and the first post-nuclear whorl. The seven remaining measure: Length 5.1 mm., diameter of antepenultimate whorl 1.3 mm., diameter of last whorl 1.7 mm. Cat. no. 162770, U.S.N.M., four specimens from San Hipolito Point. Cat. no. 162780, U.S.N.M., eight specimens from Point Abreojos, Lower California, one of which has served for our description of the nucleus.

ODOSTOMIA (CHRYSALLIDA) PULCHRA de Folin.

Plate 16, fig. 1.

=*Noemia pulchra* DE FOLIN, Fonds de la Mer, vol. 2, 1872, p. 165, pl. 6, fig. 2.

Shell ovate, conic, white, subvitreous, shining. Nuclear whorls one and one-half, obliquely immersed in the first of the succeeding turns. Post-nuclear whorls well rounded, marked by four spiral cords between the sutures and equally strong axial ribs, of which

14 occur upon the second, 16 upon the third, and 18 upon the penultimate turn. Sutures well impressed. Periphery of the last whorl marked by a slender channel. Base well rounded, marked by four subequal, broad, rounded keels, the spaces between which are marked by slender riblets. Aperture subpyriform; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, strongly curved, decidedly reflected, provided with a weak fold at its insertion.

De Folin's type came from Margarita Island, Bay of Panama. It has four and one-half post-nuclear whorls and measures: Length 2.2 mm., diameter 1 mm.

ODOSTOMIA (CHRYSALLIDA) MONTEREYENSIS Dall and Bartsch.

Plate 17, fig. 6.

Odostomia (*Chrysallida*) *montereyensis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 516, pl. 46, fig. 4.

Shell broadly conic, milk-white to subdiaphanous. Nuclear whorls smooth, largely immersed in the first of the succeeding turns, above which only half of the last whorl projects. Post-nuclear whorls separated by broad, deep sutures; well rounded between the sutures where they are ornamented by four strongly tuberculate spiral ridges; the spiral connections between the tubercles are equal to the axial connections or ribs, of which 16 appear upon the second, 18 upon the thirtieth, and 20 upon the penultimate whorl. The spaces inclosed between the axial ribs and the spiral connections which join the rounded tubercles are deep, squarish pits. The axial ribs extend strongly across the deep peripheral channel and stop at the first subperipheral keel. Base moderately long, well rounded, marked by five equal and subequally spaced, well raised, strong, spiral keels, and a sixth, much broader, low, and rounded at the columellar margin. The grooves between the keels are equal to the width of the keels near the periphery, but diminish in breadth successively from the periphery to the umbilical area. They are crossed by numerous slender, raised, axial threads, which extend up on the sides of the spiral keels, but do not cross them. There are about five of these threads between each two ribs in the first subperipheral channel; aperture oval, somewhat effuse anteriorly; posterior angle acute; columella reënforced by the attenuated base, against which it appears like a thickened callus, provided with a moderately strong oblique fold at its insertion; parietal wall covered by a thick callus, which joins the columella with the posterior angle of the aperture.

The type (Cat. no. 196281, U.S.N.M.) has 5 post-nuclear whorls and measures: Length 3 mm., diameter 1.3 mm. It was collected by Mr. S. S. Berry, in 12 fathoms, off Del Monte, Monterey Bay, California. Three specimens from the same station are in Mr. Berry's collection. Another specimen (Cat. no. 74003, U.S.N.M.) was collected by Doctor Canfield at Monterey, and a sixth (Cat. no. 196282, U.S.N.M.) by Mr. F. L. Button at the same place. A seventh (Cat. no. 162767, U.S.N.M.) was collected by Mrs. T. S. Oldroyd at San Luis Obispo, California.

ODOSTOMIA (CHRYSALLIDA) PULCIA, new species.

Plate 16, figs. 10, 10*a*.

Shell small, ovate, vitreous. Nuclear whorls deeply, very obliquely immersed in the first of the post-nuclear whorls, above which only the tilted edge of the last volution projects, which is marked by five slender spiral threads. Post-nuclear whorls well rounded, strongly contracted at the sutures and shouldered at the summits, marked by very strong, decidedly retractively curved, axial ribs, of which 16 occur upon the first, 18 upon the second, and 20 upon the penultimate turn. In addition to the axial ribs, the whorls are marked between the sutures by four very broad, low, spiral bands, which are separated by mere impressed lines, and which render the axial ribs feebly tuberculated. Suture subchanneled. Periphery of the last whorl marked by a narrow deep groove, which is not crossed by the axial ribs. Base well rounded, crossed by six spiral cords which grow decidedly weaker and closer spaced from the periphery to the umbilical area, the spaces between them being crossed by numerous slender, axial threads. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella stout, strongly reflected anteriorly, provided with a weak fold at its insertion.

The type and 35 specimens (Cat. no. 162763, U.S.N.M.) come from San Pedro, California. The type has four post-nuclear whorls and measures: Length 2.2 mm., diameter 1.2 mm. Seventy specimens from the same locality were identified for Mrs. Oldroyd. Cat. no. 168568, U.S.N.M., thirty-seven specimens also from San Pedro.

ODOSTOMIA (CHRYSALLIDA) VIRGINALIS, new name.

=*Evalea gracilienta* (CARPENTER) KEEP, West Coast Shells, 1888; p. 52; not *Odostomia gracilienta* MONTEROSOTO, 1884.

Plate 18, figs. 7, 7*a*.

Shell elongate-conic, thin, semitranslucent. Nuclear whorls obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects, which is marked by three strongly elevated spiral threads. Post-nuclear whorls well-rounded, moderately contracted at the sutures, and strongly slopingly shouldered, marked by weak rounded axial ribs which are best developed near the edges of the shoulder. Of these ribs about 24 are indicated on the first turn, 18 upon the second to fourth, and 20 upon the penultimate turn. In addition to the axial sculpture the whorls are marked between the sutures by a number of spiral keels of diverse strength, of which 4 occur upon the first and second, 5 upon the third, 6 upon the fourth and the penultimate whorl. Of these spiral ridges the second one below the summit is the strongest and marks the angle of the shoulder. The junction of the ribs and cords form feeble nodules best shown at the shoulder. Sutures strongly constricted. Periphery of the last whorl marked by a low cord. Base well rounded, marked by four low, broad cords and seven exceedingly fine incised lines, the latter about the umbilical area. The narrow, strongly incised grooves which separate the cords are crossed by numerous fine axial threads, which give them a pitted appearance. Aperture oval, slightly effuse anteriorly; posterior angle acute; outer lip rendered slightly wavy by the external cords, thin, showing the external sculpture within; columella slender, curved, provided with a deep-seated fold at its insertion.

The type and ten specimens (Cat. no. 46152, U.S.N.M) come from Todos Santos Bay, Lower California. The type has six post-nuclear whorls and measures: Length 3 mm., diameter 1.1 mm.

This is the most variable and the most abundant member of the subgenus *Chrysallida*. On some the axial ribs extend only over the first two cords below the summit, on others they extend strongly over the periphery and part of the base. The spiral cords also vary in number and strength. The general form, however, seems quite constant.

The following specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	Locality.	Disposition of material.
158570	48	Whites Point, San Pedro, California	U. S. Nat. Mus.
	10	.....do	Oldroyd coll.
	47	San Pedro, California	Do.
	1	Arch Beach, San Diego, California	Univ. Cal. coll.
127546	4	San Hipolito Point, Lower California	U. S. Nat. Mus.
105474	4	Point Abreojos, Lower California	Do.
106499	4	.....do	Do.
60914	1	Todos Santos Bay, Lower California	Do.
46177	1	.....do	Do.
46152	11	.....do	Do.

ODOSTOMIA (CHRYSALLIDA) DEFOLINIA, new name.

Plate 17, fig. 5.

Noemia angusta de Folin, Fonds de la Mer, vol. 2, 1872, p. 165, pl. 6, fig. 7; not *Chrysallida angusta* Carpenter, 1864.

Shell conic, crystalline, shining. Nuclear whorls one and one-half, the greater part immersed in the first of the succeeding turns. Post-nuclear whorls flattened, marked by four spiral ridges between the sutures and axial ribs, the intersections of which form low squarish tubercles of which about 14 occur upon the second and 18 upon the penultimate whorl. Suture poorly impressed. Periphery of the last whorl marked by a spiral cord. Base attenuated, marked by six equally spaced spiral cords and slender axial threads in the grooves between the cords. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella moderately strong, slightly curved, provided with a strong fold a little below its insertion.

De Folin's type comes from Margarita Island, Bay of Panama. It has five post-nuclear whorls and measures: Length 3.6 mm., diameter 1.5 mm. De Folin's figure, which we copy, not having seen any specimens of this species, is inconsistent, in showing five spiral cords on the second and third whorls.

ODOSTOMIA (CHRYSALLIDA) DEFOLINIA CONTRACTA de Folin.

Noemia angusta var. *contracta* DE FOLIN, Fonds de la Mer, vol. 2, 1872, p. 165.

Of this form de Folin says:[a] "Shell similar to *Noemia angusta* but smaller, less ventricose, and more oval; length 3 mm., diameter 1.2 mm."

ODOSTOMIA (CHRYSALLIDA) DEFOLINIA DIFFICILIS, new name.

=*Noemia angusta* var. *ovata* DE FOLIN, Fonds de la Mer, vol. 2, 1872, p. 165; not *Chrysallida ovata* CARPENTER, 1856.

Of this form de Folin says:[a] "Shell similar to *Noemia angusta* but smaller, with a spire more ovate, and the whorls more convex; aperture broader; outer lip crenulate; columella less expanded; length 2.7 mm., diameter 1.3 mm."

ODOSTOMIA (CHRYSALLIDA) OREGONENSIS Dall and Bartsch.

Plate 17, figs. 3, 3*a*.

Odostomia (*Chrysallida*) *oregonensis* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 516, 517, pl. 46, figs. 10, 10*a*.

Shell elongate-conic, slender, subdiaphanous to milk-white. Nuclear whorls immersed, the last one only being visible. This is somewhat tilted and marked by three strong narrow spiral keels and many slender raised axial threads which cross the grooves between the keels. Post-nuclear whorls well rounded, slopingly shouldered at the summit and separated by constricted sutures, ornamented by almost equal and equally spaced spiral keels and axial ribs between the sutures on the spire. There are 4 spiral keels on the first, second, and third whorls, 6 on the fourth, and 7 upon the penultimate whorl. The first of these keels is on the shoulder of the whorl near the summit and is somewhat less developed than the rest. The axial ribs are best developed on the early whorls, where they extend equally strong from the summit to the periphery; on the antepenultimate and penultimate turns they become somewhat enfeebled from the middle of the whorl between the sutures to the periphery. There are about 16 of these ribs on the first, 18 on the third, 20 upon the fourth, and 22 upon the penultimate turn. The intersections of the ribs and spiral keels form low elongated tubercles, the long axis of which coincides with the spiral sculpture. The meshes inclosed by the keels and ribs are deeply impressed squarish pits. Periphery and base of the last whorl well rounded, the latter somewhat inflated and marked by six spiral cords, which are successively closer spaced and a little less strongly developed from the periphery to the umbilical area. The channels between the cords are crossed by many very slender raised vertical threads. Aperture oval, slightly effuse anteriorly; outer lip thin; columella reënforced on its posterior two-thirds by the attenuated base, free and somewhat revolute anteriorly; parietal wall glazed by a thin callus.

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[a] Fonds de la Mer, vol. 2, 1872, p. 165.

The type has six post-nuclear whorls and measures: Length 3.3 mm., diameter 1.2 mm. It and nine additional specimens are Cat. no. 107690, U.S.N.M., and were collected by Dr. C. F. Newcombe at Cumshewa Inlet, Queen Charlotte Island, British Columbia, in 10 fathoms. Two other lots of one specimen each come from Monterey, Cat. no. 73998, U.S.N.M., in the Stearns collection, and Cat. no. 196283, U.S.N.M., collected by Mr. F. L. Button.

ODOSTOMIA (CHRYSALLIDA) BENTHINA, new name.

Plate 17, figs. 9, 9*a*.

Chrysallida oblonga CARPENTER, Cat. Mazatlan Shells, 1856, pp. 418–19; not *Odostomia oblonga* MACGILLIVRAY, 1848.

Shell elongate-conic, white. Nuclear whorls small, deeply obliquely immersed in the first post-nuclear turn, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, marked by slender, nodulous, retractive axial ribs, which terminate at the posterior extremity of the supra-peripheral cord, leaving this smooth. Of these ribs about 35 occur upon the first whorl, 28 upon the second and third, 22 upon the fourth, and 26 upon the penultimate turn. In addition to the axial ribs, the whorls are marked by five strong, spiral cords, the junction of which with the ribs form tubercles. Periphery of the last whorl marked by a groove. Base well rounded, ornamented with seven equal and equally spaced spiral cords, the grooves between which are marked by fine, raised axial threads. Aperture pyriform, somewhat effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, curved, and reflected, provided with an oblique fold at its insertion; parietal wall covered with a thin callus.

Four specimens were taken from *Spondylus* at Mazatlan, Mexico. Tablet 1971, Liverpool collection, British Museum, contains the largest specimen and a very young shell. The large one has six post-nuclear whorls and measures: Length 4.8 mm., diameter 1.7 mm.

ODOSTOMIA (CHRYSALLIDA) PROMECES, new species.

Plate 18, figs. 2, 2*a*.

Shell elongate-ovate, vitreous. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects, which is marked by five slender spiral threads. Post-nuclear whorls well rounded, strongly contracted at the periphery and slightly shouldered at the summit, marked on all but the first whorl, which is but feebly sculptured, by strong, rounded, decidedly retractive axial ribs, of which 14 occur upon the second, 16 upon the third, and 20 upon the penultimate turn. In addition to the ribs, the whorls are marked between the sutures, by four low, broad, spiral bands, separated by narrow channels which render their junction with the ribs decidedly nodulous. On the last two whorls the peripheral cord is apparent in the strongly constricted suture. Periphery of the last whorl marked by a strong cord. Base well rounded, marked by three subequal spiral cords and a plain area about the umbilicus. The grooves separating these cords are marked by many slender axial threads. Aperture ovate, posterior angle obtuse; outer lip thin, showing the external sculpture within; columella moderately strong, slightly reflected, reënforced by the base, provided with a fold at its insertion.

The type (Cat. no. 162777, U.S.N.M.) comes from Todos Santos Bay, Lower California. It has five post-nuclear whorls and measures: Length 2.5 mm., diameter 1.1 mm.

ODOSTOMIA (CHRYSALLIDA) PULCHERRIMA, new species.

Plate 17, fig. 7.

Shell large, elongate-oval, vitreous. Nuclear whorls small, smooth, deeply obliquely immersed in the first post-nuclear turn, above which only the tilted edge of the last volution projects. Post-nuclear whorls strongly rounded, decidedly contracted at the sutures and strongly shouldered at the summit. The first is marked by four slender spiral cords and numerous exceedingly fine axial threads. The next three have twenty strong, rounded, axial ribs, which terminate at the posterior edge of the fourth keel, leaving this smooth. On the last whorl the ribs are decidedly enfeebled, being replaced by numerous axial threads. The spiral sculpture consists of four strong cords between the sutures, the three which cross the ribs form strong nodules at their junction with them, while the supraperipheral one is smooth. Suture strongly impressed, slightly channeled. Periphery and base of the last whorl well rounded, marked by eight spiral keels, which grow successively weaker from the periphery to the umbilical region, the last three being very fine. Spaces separating the cords equal to them, crossed by numerous slender, axial threads. Aperture irregularly ovate, posterior angle obtuse; outer lip strong, rendered decidedly sinuous by the axial ribs; columella short, decidedly twisted, strongly curved, reflected, reënforced by the base and provided with a deep-seated fold at its insertion; parietal wall glazed with a thin callus.

The type (Cat. no. 206900, U.S.N.M.) comes from Terminal Island, California. It has six post-nuclear whorls and measures: Length 5 mm., diameter 2.3 mm.

ODOSTOMIA (CHRYSALLIDA) VINCTA, new species.

Plate 17, fig. 4.

Shell elongate-ovate, white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns. Post-nuclear whorls flattened, strongly contracted at the periphery, well shouldered at the summit, marked by strong, somewhat retractive axial ribs, which terminate at the posterior edge of the first supraperipheral keel, which is smooth. Of these ribs, 18 occur upon the second, 20 upon the third, 22 upon the fourth, and 27 upon the penultimate turn. In addition to the axial ribs the whorls are marked by four spiral keels, which equal the ribs in strength and render their junction nodulous. The spaces inclosed by the axial ribs and spiral cords are well impressed round pits. Sutures strongly channeled. Periphery of the last whorl marked by a strong groove. Base of the last whorl well rounded, marked by five spiral cords, which grow successively a little weaker from the periphery to the umbilical area. The spaces between these cords are marked by slender spiral threads, which correspond to the ribs on the spire. Aperture oval, posterior angle obtuse; outer lip thin, rendered wavy by the spiral cords; columella moderately strong, decidedly curved, reflected, and reënforced by the base, provided with a slender fold at its insertion.

The type (Cat. no. 162762, U.S.N.M.) comes from San Pedro, California. It has six post-nuclear whorls and measures: Length 2.7 mm., diameter 1.3 mm. Another specimen was identified for Mr. Berry from the same locality.

ODOSTOMIA (CHRYSALLIDA) FASCIATA Carpenter.

Plate 17, fig. 2.

Chrysallida fasciata CARPENTER, Cat. Mazatlan Shells, 1856, p. 423.

Shell elongate-ovate, white. Nuclear whorls small, obliquely immersed in the first of the succeeding turns. Post nuclear whorls moderately rounded, ornamented by decidedly retractive axial ribs which practically terminate at the posterior edge of the supraperipheral spiral keel. Of these ribs, 12 occur upon the first, 14 upon the second, 18 upon the third, and 22 upon the penultimate turn. In addition to these ribs the whorls are marked by four spiral keels between the sutures which equal the ribs in strength and render the three anterior to the summit tuberculated at their junction, the fourth one being smooth. Sutures strongly channeled. Periphery of the last whorl marked by a groove. Base well rounded, marked by six slender spiral keels, which are a little less strongly developed and more closely spaced at the umbilical area than at the periphery. Grooves separating these keels, about twice as wide as the keels, crossed by slender axial threads which correspond to the ribs. Aperture ovate, somewhat effuse anteriorly; posterior angle obtuse; outer lip sinuous, thin, showing the external sculpture within; columella moderately strong, reflected, provided with a slender fold at its insertion; parietal wall glazed with a thin callus.

Twenty specimens were taken off *Spondylus* at Mazatlan, Mexico. Tablet 1981, Liverpool collection, British Museum, contains five specimens, one of which has five post-nuclear whorls and measures: Length 2.1 mm., diameter 1.1 mm.

ODOSTOMIA (CHRYSALLIDA) HELGA, new species.

Plate 17, figs. 8, 8*a*.

Shell conic, milk-white. Nuclear whorls smooth, deeply obliquely immersed in the first of the succeeding whorls, above which only a portion of the last two volutions project. Post-nuclear whorls moderately rounded, slightly contracted at the sutures, feebly shouldered at the summits, marked between the sutures by four broad low spiral bands which are separated by narrow, deeply incised lines. In addition to these bands, the first three and one-half whorls are marked by feeble axial ribs which are best developed near the summit of the whorls and scarcely reach the suture. The junction of the ribs and cords form weak nodules. Sutures strongly impressed but not channeled. Periphery of the last whorl well rounded, marked by a low spiral cord. Base strongly rounded posteriorly, attenuated anteriorly, marked by seven spiral cords, which grow successively weaker from the periphery toward the umbilical region and are separated by slender, deeply-incised spiral lines. Aperture large, broadly oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella moderately strong, curved, reflected, and reinforced by the base; provided with an oblique fold at its insertion.

The type (Cat. no. 60905, U.S.N.M.) and ten specimens come from San Diego, California. The type has six post-nuclear whorls and measures: Length 4.2 mm., diameter 2 mm.

Examination of the following specimens has been made:

U.S.N.M. cat. no.	No. of specimens.	Locality.	Disposition of material.
60905	11	San Diego, California	U. S. Nat. Mus.
162774	100	San Pedro, California	Do.
	190	.....do	Oldroyd coll.
206901	9	San Pedro Bay, California	U. S. Nat. Mus.
206902	11	Terminal Island, California	Do.
162773	6	Pacific Beach, California	Do.
	1	Arch Beach, California	Univ. Cal. coll.

ODOSTOMIA (CHRYSALLIDA) SANCTORUM, new species.

Plate 18, fig. 1.

Shell elongate-ovate, light yellow. Nuclear whorls smooth, deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls moderately rounded, very slightly contracted at the sutures, moderately shouldered at the summits, marked by a strongly incised spiral line a little distance below the summit, and three feeble ones of which one is at the periphery, the other two dividing the space between those two into three equal areas. These lines, excepting the one near the summit, which is strong throughout, are best developed on the early whorls. In addition to the spiral sculpture, the whorls are marked between the sutures by strong lines of growth and indications of feeble axial ribs which tend to render the early whorls somewhat nodulous. Sutures strongly impressed. Periphery of the last whorl strongly inflated. Base well rounded posteriorly, slightly attenuated anteriorly, marked by six well incised equal and subequally spaced spiral grooves which are crossed by many slender axial threads. Aperture large, oval, effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella moderately strong, curved, reflected, reinforced by the base, provided with a deep-seated fold.

The type and three specimens (Cat. no. 46499, U.S.N.M.) comes from Todos Santos Bay, Lower California. The type has four and one-half post-nuclear whorls and measures: Length 2.5 mm., diameter 1.3 mm. Cat. no. 206803, U.S.N.M., three from San Hipolito Point, Lower California.

ODOSTOMIA (CHRYSALLIDA) SAPIA, new species.

Plate 18, figs. 3, 3*a*.

Shell oval, semitranslucent. Nuclear whorls small, deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects, which is marked by five slender spiral threads. Post-nuclear whorls amply rounded, slightly constricted at the sutures and appressed at the summits, marked by six spiral cords between the sutures, of which the second and third below the summit are very narrow, occupying together about as much space as one of the other cords. These cords are separated by grooves which almost equal them. Axial sculpture reduced to feeble indications of ribs which are best shown near the summit of the whorls, where they render the spiral keels feebly nodulous. About twenty-two of these ribs appear upon the penultimate whorl. Periphery and base of the last whorl well rounded, marked by seven spiral keels, which grow successively weaker from the periphery to the umbilical area. Channels separating the cords narrow, well incised, crossed by numerous slender axial threads. Aperture large, broadly ovate, posterior angle acute; outer lip thin; columella moderately strong, curved, slightly reflected; parietal wall glazed with a thin callus.

The type (Cat. no. 162775, U.S.N.M.) comes from San Diego, California. It has four post-nuclear whorls and measures: Length 1.8 mm., diameter 1.1 mm.

ODOSTOMIA (CHRYSALLIDA) ROTUNDATA Carpenter.

Plate 18, fig. 4.

Chrysallida rotundata CARPENTER, Cat. Mazatlan shells, 1856, p. 418.

Shell ovate. Nuclear whorls two and one-half, forming a depressed helicoid spire whose axis is at right angles to that of the succeeding turns. Póst-nuclear whorls well rounded, moderately contracted at the sutures, very slightly shouldered at the summit, marked by five strong spiral keels on all the whorls between the sutures, excepting the first which has four and obsolete axial ribs on the first two. These axial ribs are best expressed near the summit of the whorls, scarcely reaching the suture, and rendering the spiral cords feebly tuberculate. On the last whorl the axial sculpture is reduced to numerous raised axial threads, like those between the cords on the base. Suture poorly defined. Base of the last whorl well rounded, marked by six spiral cords of which the two anterior ones are a little weaker than the rest; separated by spaces which are a little narrower than the cords and crossed by numerous fine axial threads. Aperture pyriform, posterior angle acute; outer lip thin, showing the external sculpture within; columella stout, curved, provided with a weak fold at its insertion; parietal wall covered with a thin callus.

Nine complete shells and a few fragments were found on *Spondylus* at Mazatlan, Mexico. Tablet 1970, Liverpool collection, British Museum, contains two specimens. One of these has four post-nuclear whorls and measures: Length 2.3 mm., diameter 1.1 mm.

ODOSTOMIA (CHRYSALLIDA) DECEPTRIX, new species.

Plate 17, fig. 1.

Shell ovate, white. Nuclear whorls smooth, deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls somewhat inflated, constricted at the sutures and feebly shouldered at the summits, marked by four equal well incised, spiral lines between the sutures and numerous very retractive lines of growth, with a few feeble indications of axial ribs, at and near the summit, which renders the first and sometimes the second space between the incised lines below the summit feebly nodulous. Suture strongly impressed. Periphery and base of the last whorl somewhat inflated, well rounded, marked by seven incised spiral lines, which decrease regularly in spacing from the periphery to the umbilical area. Aperture broadly oval; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella quite strong, strongly curved, provided with a strong fold at its insertion; parietal well glazed with a thin callus.

The type and four specimens (Cat. no. 206904, U.S.N.M.) comes from San Hipolito Point, Lower California. The type has five post-nuclear whorls and measures: Length 2.8 mm., diameter 1.3 mm. Cat. no. 206905, U.S.N.M., contains three specimens from Point Abreojos, Lower California.

Subgenus PYRGULINA A. Adams.

Pyrgulina A. Adams, Journ. Linn. Soc. London (Zool.), 1863, p. 4.

Shell with strong axial ribs which extend from the summit to the umbilical area; intercostal spaces of spire and base marked by fine incised spiral lines—not raised threads.

Type.—*Chrysallida casta* A. Adams.

ODOSTOMIA (PYRGULINA) MARGINATA C. B. Adams.

Plate 18, figs. 5, 5*a*.

Chemnitzia marginata C. B. Adams, Ann. Lyc. Nat. Hist. of N. Y., vol. 5, 1852, pp. 391, 392.

Shell small, elongate-conic, rather stout, semitranslucent. Nuclear whorls small, two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fourth immersed. Post-nuclear whorls flattened, moderately contracted at the sutures and slightly shouldered at the summit, marked by very strong, lamellar, somewhat retractive axial ribs, of which 14 occur upon all of the whorls. The termination of these ribs form cusps at the summits. Intercostal spaces four times as wide as the ribs, marked by six equal and equally spaced incised lines, the space between the summit and the first line below it appearing as a thickened cord. Sutures well impressed. Periphery of the last whorl and base well rounded, marked by the strong continuation of the axial ribs and about five incised spiral lines. Aperture ovate; posterior angle acute; outer lip thin, showing the external sculpture within; columella stout, slightly curved and some what revolute; parietal wall covered by a very strong callus.

Professor Adams's type, which comes from Panama, has served for our description and figure. It is at Amherst College. It has six and one-half post-nuclear whorls and measures: Length 2.8 mm., diameter 1.1 mm.

Subgenus EGILA Dall and Bartsch.

Egila DALL and BARTSCH, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 11.

Odostomias with the axial ribs extending from the summit of the whorls to the umbilical region; periphery with a deep sulcus bounded on each side by a tumid area; the base is spirally striated.

Type.—*Parthenia lacunata* Carpenter.

KEY TO THE SPECIES OF THE SUBGENUS EGILA.

Axial ribs about 18 upon the last whorl	*lacunata.*
Axial ribs about 30 on the last whorl	*poppei.*

ODOSTOMIA (EGILA) LACUNATA Carpenter.

Plate 19, fig. 1.

Parthenia lacunata CARPENTER, Cat. Mazatlan Shells, 1856, p. 414.

Shell small, oval, white. Nucleus almost completely obliquely immersed in the first of the succeeding turns. Post-nuclear whorls flattened, with subtabulated summits and deeply sulcated periphery, marked by sublamellar, slightly retractive axial ribs, of which 14 occur upon the first and second and 18 upon the penultimate turn. Intercostal spaces three times as wide as the ribs, smooth. Periphery deeply and broadly sulcate, bordered on each side by a low spiral cord, crossed by the continuations of the axial ribs. Base of the last whorl well rounded, marked by the axial ribs which continue almost undiminished to the umbilical chink and about twelve spiral lirations. Aperture oval; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, curved, and slightly revolute; parietal wall covered by a thin callus.

Doctor Carpenter's type, which is on tablet 1964 Liverpool collection, British Museum, and six specimens were taken from *Spondylus* at Mazatlan, Mexico. The type has four post-nuclear turns and measures: Length 1 mm., diameter 0.57 mm.

ODOSTOMIA (EGILA) POPPEI, new species.

Plate 19, fig. 3.

Shell elongate-ovate, milk-white. Nuclear whorls small, completely obliquely immersed in the first post-nuclear turn above which the tilted edge of the last volution only projects. Post-nuclear whorls slightly rounded, strongly tabulatedly shouldered at the summit, and decidedly sulcate at the periphery, marked by strong, well-rounded, curved, somewhat retractive axial ribs, of which 22 occur upon the second, 26 upon the third, and 30 upon the penultimate turn; on the first they are obsolete. Intercostal spaces well impressed, about as wide as the ribs. The posterior edge of the peripheral sulcus coincides with the summits of the whorls, which render the sutures profoundly channeled. The sulcus is bordered on each side by a well-rounded, slender, spiral cord, which forms low tubercles at the junction with the ribs. The peripheral sulcus is crossed by the undiminished axial ribs, which break it up into a series of deep pits. Base of the last whorl somewhat attenuated, with a shallow pit at the umbilical region, marked by the continuations of the axial ribs, which here have a decidedly retractive slant, and about twelve slender, spiral lirations. Aperture oval; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella stout, curved, reënforced by the base, provided with a well-developed fold at the insertion of the columella; parietal wall covered by a thin callus.

The type (Cat. no. 106519, U.S.N.M.) and another specimen come from Point Abreojos, Lower California. The type has five post-nuclear whorls and measures: Length 2.2 mm., diameter 1.1 mm.

Three additional specimens from the same locality have been examined in Mr. Delos Arnold's collection.

Named for Professor Ewald Poppe.

Subgenus HALDRA Dall and Bartsch.

Haldra Dall and Bartsch, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 11.

Odostomias with more or less irregular, acute axial ribs extending from the summits of the whorls to the umbilical region, crossed by subequally spaced acute spiral ridges between the sutures and on the base. The intersections of the ribs and spiral ridges are thickened, but scarcely nodulous, lending the shell a very rough appearance.

Type.—*Chrysallida photis* Carpenter.

ODOSTOMIA (HALDRA) PHOTIS Carpenter.

Plate 18, fig. 8.

Chrysallida photis Carpenter, Cat. Mazatlan Shells, 1856, p. 425; +*Chrysallida clathratula* Carpenter, Cat. Mazatlan Shells, 1856, p. 424; not *Chemnitzia clathratula* C. B. Adams.

Shell small, pupiform, white. Nuclear whorls at least two, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-half immersed. Post-nuclear whorls well rounded, moderately concontracted at the suture, slightly shouldered at the summit, marked by strongly raised, narrow, somewhat retractive axial ribs, of which 12 occur upon the first, 14 upon the second, and about 20 upon the penultimate turn. In addition to the axial ribs the whorls are marked between the sutures by five strong, narrow, spiral keels which render the intersections of the ribs cuspidate. Sutures well impressed. Periphery and base of the last whorl well rounded, marked by the strong continuations of the axial ribs and five spiral keels, similar to those between the sutures. Aperture pear-shaped; outer lip thin, showing the external sculpture within; columella strongly curved and revolute, provided with a weak fold at its insertion; parietal wall covered with a thin callus.

The type and another specimen were taken off *Spondylus*, at Mazatlan, Mexico. The type has five post-nuclear whorls and measures: Length 1.2 mm., diameter 0.48 mm. The type is on tablet 1985, Liverpool collection, British Museum. Another specimen taken from *Chama* at Mazatlan, is on tablet 1983, Liverpool collection. It is listed as *Chrysallida clathratula* C. B. Adams.

IVIDELLA, new subgenus.

=*Funicularia* MONTEROSATO, Conch. Med., 1884, p. 85. Type.—*Rissoa excavata* PHILIPPI; not *Funicularia* LAMARCK. + *Ividia* (species), DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 517–18.

Odostomias marked with lamellar spiral ridges and equally strong lamellar axial ribs, both of which ornament spire and base.

Type.—Odostomia (*Ividia*) *navisa* Dall and Bartsch.

When we diagnosed *Ividia*[a] we unfortunately selected *Parthenia armata* Carpenter as type. Since then we have examined Doctor Carpenter's type of *Parthenia armata* in the British Museum and find that the species must be referred to *Miralda*, which necessitates the selection of a new type for the group defined. Since this can not be done without change of name, we propose *Ividella*.

Type.—Odostomia (*Ividia*) *navisa* Dall and Bartsch.

KEY TO THE SPECIES OF THE SUBGENUS IVIDELLA.

Base with a single spiral lamella..*pedroana*, p. 172.
Base with two spiral lamellæ.
    Diameter of shell more than 1.2 mm.
        Shell robust, short..*navisa*, p. 173.
        Shell thin, slender..*n. delmontensis*, p. 174.
    Diameter of shell less than 1 mm..*orariana*, p. 175.
Base with three spiral lamellæ..*quinquecincta*, p. 174.

ODOSTOMIA (IVIDELLA) PEDROANA, new species.

Plate 19, figs. 8, 8*a*.

Shell large, robust, chocolate-brown. Nuclear whorls two, moderately large, forming a helicoid spire whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fifth immersed. Post-nuclear whorls very strongly sculptured, with three spiral keels between the sutures, one of which at the summit is slender, the other two are strong and equal, the supra-peripheral one being about as far posterior to the suture as the one at the summit is from its neighbor. In addition to the spiral keels the whorls are marked by narrow retractive axial ribs, of which 14 occur upon the first, 16 upon the second to third, 18 upon the fourth, 20 upon the fifth and sixth, and 24 upon the penultimate turn. The junctions of the axial ribs and spiral keels are somewhat tuberculated, while the spaces inclosed between them are deeply impressed pits. A strong keel marks the periphery of the last whorl and another equally strong occupies the middle of the base, the space between them being a concave channel, which, like the one posterior to the peripheral keel, is crossed by the axial ribs. The axial ribs become much enfeebled as they pass over the basal keel and are almost obsolete on the spaces anterior to it. Aperture irregularly oval; posterior angle obtuse; outer lip thin, rendered angular by the spiral keels; columella very strong, almost straight, slightly reflected; parietal wall covered by a thin callus.

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[a] Proc. Biol. Soc. Wash., vol. 17, 1904, p. 11.

The type (Cat. no. 107422, U.S.N.M.) comes from San Pedro, California. It has eight post-nuclear whorls, and measures: Length 6.7 mm., diameter 2.5 mm.

We have examined the following specimens:

U.S.N.M. cat. no.	No. of specimens.	U. S. B. F. station.	Locality.	Depth, fathoms.	Collector.	Disposition of material.
162845	1		San Pedro, California		H.N.Lowe	U. S. N. Mus.
152171*a*	4		do		Johnston	Do.
	9		do		Oldroyd	Oldroyd coll.
	2		San Pedro (Whites Point).		do	Do.
46162	2		Catalina Island, California.	12		U. S. N. Mus.
162846	5	3566	San Diego, California	3		Do.
162847	7	3572	do	2		Do.
109364	4		do			Do.
	2		do		Oldroyd	Oldroyd coll.
160094	1		San Diego (off Coronado Hotel), California.		Kelsey	U. S. N. Mus.
74022	4		do			Do.
32305	1		do			Do.
106425	1		Scammon Lagoon, Lower California.			Do.

ODOSTOMIA (IVIDELLA) NAVISA Dall and Bartsch.

Plate 18, figs. 11, 11*a*.

Odostomia (*Ividia*) *navisa* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 517, 518, pl. 46, figs. 2, 2*a*.

Shell of medium size, strongly sculptured, subdiaphanous to milk-white. Nuclear whorls at least two, obliquely a little more than half immersed. Post-nuclear whorls strongly shouldered, subtabulated, with a strong, broad, spiral keel limiting the anterior edge of the shoulder and an acute raised keel on the middle of the whorls between the sutures, while a third equally acute keel marks the periphery of the last whorl. Two other keels ornament the base, the anterior one of which is not quite as strong as its neighbor. The axial sculpture consists of narrow, more or less lamellar, almost vertical ribs, which render the intersection with the spiral keels somewhat thickened, but not nodulose. These axial ribs extend over the periphery and base of the last whorl to the umbilical region, gradually growing weaker as they approach this point. There are about 18 on the second and 20 upon the penultimate whorl. The spaces between the ribs and keels appear as concave quadrangular depressions. Umbilicus narrowly perforated. Suture deeply channeled by the shouldered whorl. Aperture suboval, posterior angle decidedly obtuse; outer lip thick, marked by 5 projections, corresponding to the 5 keels; columella almost straight, strongly revolute with a conspicuous oblique fold near its insertion; parietal wall covered by a faint callus showing both basal keels, the anterior faint and just posterior to the insertion of the columella and the next on the middle of the wall.

The type has 5 post-nuclear whorls and measures: Length 2.7 mm., diameter 1.3 mm. It and three additional specimens (Cat. no. 106502, U.S.N.M.) were collected by Mr. Henry Hemphill at Scammon Lagoon, Lower California. Three additional lots are in the U. S. National Museum collection: Cat. no. 129336, 30 specimens collected by Mrs. T. S. Oldroyd in the drift at San Pedro; Cat. no. 162843, 3 specimens also from San Pedro by the same donor; Cat. no. 62844, 1 specimen collected by Mr. Henry Hemphill at Ocean Beach, San Diego, California.

ODOSTOMIA (IVIDELLA) NAVISA DELMONTENSIS Dall and Bartsch.

Plate 18, figs. 10, 10*a*.

Odostomia (*Ividia*) *navisa delmontensis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 518, pl. 46, figs. 3, 3*a*.

Shell similar to *O.* (*I.*) *navisa* but more elongate, and in every way more delicate, with the lamellose sculpture reduced almost to raised cords and with stronger shouldered summits and more open umbilicus.

The type (Cat. no. 196297, U.S.N.M.) was collected by Mr. S. S. Berry in 12 fathoms, off Del Monte, Monterey Bay, California. It has five post-nuclear whorls and measures: Length 3.2 mm., diameter 1.3 mm.

ODOSTOMIA (IVIDELLA) QUINQUECINCTA Carpenter.

Plate 18, fig. 9.

Parthenia quinquecincta Carpenter, Cat. Mazatlan Shells, 1856, p. 414.

Shell elongate-ovate. Nuclear whorls tumid, obliquely immersed. Post-nuclear whorls flattened, strongly tabulatedly shouldered at the summit, and strongly contracted at the periphery, marked by strong lamellar ribs, of which 12 occur upon the first, 14 upon the second, and 16 upon the penultimate turn. In addition to the axial ribs the whorls are marked by six strong spiral cords, one of which is at the angle of the shoulder and another at the periphery, the third falls a little anterior to the suture, while the other three divide the remainder of the base into four almost equal parts. Aperture oval, posterior angle obtuse; outer lip thin, rendered angulated by the spiral cords; columella slender, curved, and somewhat revolute, provided with an oblique fold at its insertion; parietal wall covered with a strong callus.

Two specimens were taken off *Spondylus*, at Mazatlan, Mexico. The finest of these is on tablet 1963, Liverpool collection, British Museum. It has four post-nuclear whorls and measures: Length 1.8 mm., diameter 0.6 mm.

ODOSTOMIA (IVIDELLA) ORARIANA, new name.

Plate 18, fig. 12.

Cingula (?) *turrita* C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., 1852, pp. 406, 407; not *Odostomia turrita* HANLEY, 1844.

Shell elongate, conic, turreted; milk-white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls strongly tabulately shouldered at the summit, flat in the middle, sloping suddenly toward the suture; ornamented by slender axial ribs, of which 15 occur upon the second and 18 upon the remaining whorls. In addition to the axial ribs, the whorls are marked between the sutures by two strong spiral keels, one of which is situated at the angle of the shoulder, the other at the posterior termination of the anterior third between the sutures. The junctions of the axial ribs and spiral keels are very slightly nodulous. Sutures deeply channeled. Periphery of the last whorl well rounded, marked by a spiral keel. Base well rounded, marked by two spiral keels, which divide the space between the peripheral keel and the umbilical area into three equal parts, and the continuation of the axial ribs, which are fainter on the base than on the spire. Aperture ovate; posterior angle obtuse; outer lip thin, rendered angular by the keels; columella slender, decidedly curved, reënforced by the base; parietal wall covered with a thin callus.

The type, which is at Amherst College, was collected by Prof. C. B. Adams at Panama. It has six post-nuclear whorls and measures: Length 2 mm., diameter 0.8 mm.

Subgenus MIRALDA A. Adams.

Miralda A. Adams, Jour. Linn. Soc. London, vol. 7, 1864, p. 3. +*Lia* de Folin, Fonds de la Mer, 1870, p. 515. Type, *Lia decorata* de Folin. +*Ividia* Dall and Bartsch, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 11. Type, *Parthenia armata* Carpenter.

Odostomias with very strong spiral keels between the sutures and on the base; the anterior one of which, and sometimes the one next to it, strongly crenulate; the remainder simple and acute. Base axially lirate.

Type.—*Parthenia diadema* A. Adams.

KEY TO THE SPECIES OF THE SUBGENUS MIRALDA.

- Spiral keels between the sutures 3.................................*hemphilli*, p. 176.
- Spiral keels between the sutures 2.
  - Base with 3 spiral cords.
    - Posterior keel between the sutures much wider than its neighbor.*armata*, p. 177.
    - Posterior keel between the sutures not wider than its neighbor.
      - Spiral keels between the sutures almost smooth...........*exarata*, p. 177.
      - Spiral keels between the sutures nodulose..............*terebellum*, p. 177.
  - Base with two basal cords.
    - Shell stout..*æpynota*, p. 178.
    - Shell slender...*galapagensis*, p. 179.

ODOSTOMIA (MIRALDA) HEMPHILLI, new species.

Plate 19, fig. 10.

Shell broadly conic, milk-white. Nuclear whorls deeply obliquely immersed, apparently smooth. Post-nuclear whorls well rounded, marked with three strong, equal spiral keels, the posterior two of which are tuberculate, the third one smooth. The tubercles are connected axially by slender riblets, which extend to the third keel. There are about twenty tubercles on the latter whorls, while on the early whorls they are ill defined. Sutures deeply channeled. Periphery of the last whorl marked by a smooth spiral keel, equal to the one posterior to it. Base moderately long, well rounded, marked by four spiral keels which grow successively weaker anteriorly. Aperture irregularly ovate; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella stout, provided with a strong fold at its insertion.

The type (Cat. no. 162841, U.S.N.M.) was collected at San Hipolito Point, Lower California. It has six post-nuclear whorls and measures: Length 3.5 mm., diameter 1.4 mm. Another specimen from the same locality is in Mr. Henry Hemphill's collection. Cat. no. 162842, U.S.N.M., one specimen from San Pedro, California. One specimen from Point Abreojos, Lower California, Cat. no. 106498 U.S.N.M.

Named for Henry Hemphill.

ODOSTOMIA (MIRALDA) ARMATA Carpenter.

Plate 19, fig. 6.

Parthenia armata CARPENTER, Cat. Mazatlan Shells, 1856, p. 415.

Shell elongate-conic, white. Nuclear whorls two, deeply, obliquely immersed in the first of the succeeding turns. Post-nuclear whorls marked by two strongly elevated tuberculate keels between the sutures, the posterior one of which is about twice as wide as its neighbor. Of the crenulations about 20 appear upon the second and third, 22 upon the fourth, and 24 upon the penultimate turn. Sutures strongly channeled. The periphery is marked by a slender keel, while the base has two a little weaker than the peripheral one which divides the space between this and the umbilical area into three equal parts. Aperture ovate; outer lip thin; columella rather thick, reflected and provided with a slender fold at its insertion; parietal wall provided with a thin callus.

Twelve specimens were taken off *Chama* and *Spondylus* at Mazatlan, Mexico. The most perfect specimen in the lot is on tablet 1965, Liverpool collection, British Museum. It has six post-nuclear whorls and measures: Length 2.5 mm., diameter 0.85 mm.

ODOSTOMIA (MIRALDA) EXARATA Carpenter.

Plate 19, fig. 2.

Parthenia exarata CARPENTER, Cat. Mazatlan Shells, 1856, pp. 415, 416.

Shell elongate-ovate, white. Nuclear whorls obliquely immersed, only the tilted edge of the last volution is visible. Post-nuclear whorls marked by two very strongly elevated spiral keels which divide the space between the sutures into three equal parts. The posterior of these keels shows weak crenulation. Periphery of the last whorl marked by a third keel which is almost as strong as those on the spire. A fourth keel considerably less strong occupies the middle of the base. The rounded spaces between the keels are marked by feeble lines of growth. Aperture irregularly oval; posterior angle obtuse; outer lip angulated by the keels; columella strong, reflected, provided with a weak fold at insertion; parietal wall covered with a thin callus.

Doctor Carpenter's type and another specimen were taken from *Chama* at Mazatlan, Mexico. The type is on tablet 1966, Liverpool collection, British Museum. It has five post-nuclear whorls and measures: Length 6.3 mm., diameter 0.8 mm.

ODOSTOMIA (MIRALDA) TEREBELLUM C. B. Adams.

Plate 19, fig. 4.

Cingula (?) *terebellum* C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., 1852, p. 406.

Shell elongate, ovate, milk-white. Nuclear whorls completely immersed in the first of the succeeding turns, above which the tilted edge of the last volution only projects, which shows faint traces of spiral lirations. Post-nuclear whorls ornamented with two strong spiral lamellæ, the first of which renders the summit of the whorls decidedly tabulated, while the second one is situated a little posterior to the posterior termination of the anterior third between the sutures. Both lamellæ are faintly nodulous; the posterior one slightly more so than the anterior. The deep channel between the two keels is marked by very feeble slender axial threads. Periphery of the last whorl marked by a lamella a little less strong than those between the sutures. Base with two lamellæ, the anterior of which is immediately behind the columella and much less developed than the median one, which is somewhat weaker than the peripheral lamella. The depressed spaces between these lamellæ are crossed by axial threads, as on the spire. Aperture irregularly ovate; posterior angle decidedly obtuse; outer lip rendered angular by the spiral lamellæ; columella strong, somewhat twisted, reënforced by the base.

The type, which is at Amherst College, was collected by Professor C. B. Adams in Panama Bay. It has five post-nuclear whorls and measures: Length 2.2 mm., diameter 1 mm.

ODOSTOMIA (MIRALDA) ÆPYNOTA, new species.

Plate 19, fig. 5.

Shell pupiform, translucent. Nuclear whorls small, obliquely immersed in the first post-nuclear turns, marked by four spiral cords. Post-nuclear whorls with the summits appressed, marked by two strong, spiral keels between the sutures, a third at the periphery, and a fourth on the middle of the base, the last two somewhat less strong than the rest. The posterior keel forms the strong tabulation at the summit of the whorls and is strongly tuberculated, 14 tubercles appearing upon the second and 20 upon the remaining whorls. The space between the keels is marked by rather strong lines of growth. The greatest convexity coincides with the superperipheral keel. Aperture irregularly ovate, somewhat effuse anteriorly; posterior angle obtuse; outer lip angulated by the keels, thin, showing the external markings within; columella strong, curved, without visible fold in the aperture; reënforced by the base; parietal wall covered by a thin callus.

The type and 30 specimens (Cat. no. 129335, U.S.N.M.) comes from San Pedro. The type has five post-nuclear whorls and measures: Length 1.9 mm., diameter 0.9 mm.

Examination of the following specimens has been made:

U.S.N.M. cat. no.	No. of specimens.	Locality.	Disposition of material.
129335	31	San Pedro, California	U. S. Nat. Mus.
105467	3	San Diego, California	Do.
16222	1	Cape St. Lucas, Lower California	Do.
	23	San Pedro, California	Oldroyd coll.
	2	Whites Point, California	Do.
	1	Catalina Island, California	S. S. Berry coll.

ODOSTOMIA (MIRALDA) GALAPAGENSIS, new species.

Plate 19, fig. 7.

Shell conic, milk-white. Nuclear whorls at least two, forming a depressed helicoid spire, which is slightly tilted to one side and for the greater part immersed in the first of the succeeding turns. The tilted edge of the nucleus shows traces of spiral lirations. Post-nuclear whorls appressed at the summit, ornamented by two very strong, lamelliform keels, whose edges are decidedly upturned, forming deeply channeled troughs. The posterior of the two lamellæ is feebly crenulated. Periphery of the last whorl marked by a spiral keel which is about half as strong as those between the sutures. A fourth keel, a little weaker than the peripheral one, marks the middle of the base. The deep concave channels between the keels are marked by strong lines of growth. Sutures strongly channeled. Aperture irregularly oval; posterior angle obtuse; outer lip rendered angular by the spiral keels; columella stout, curved, reënforced by the base; parietal wall covered with a thin callus.

The type (Cat. no. 206906, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2813, in 40 fathoms, on coral sand bottom, near the Galapagos Islands. It has six post-nuclear whorls and measures: Length 2.0 mm., diameter 0.8 mm.

Subgenus IVARA Dall and Bartsch.

Ivara Dall and Bartsch, Mem. Cal. Acad., vol. 3, 1903, p. 285; Proc. Biol. Soc. Wash., vol. 17, 1904, p. 11.

Odostomias having feebly developed axial ribs which are usually only indicated near the summits of the whorls; spiral sculpture consisting of many subequally spaced fine lirations; summits of the whorls strongly tabulated.

Type.—*Odostomia* (*Ivara*) *turricula* Dall and Bartsch.

ODOSTOMIA (IVARA) TURRICULA Dall and Bartsch.

Plate 19, fig. 9.

Odostomia (*Ivara*) *terricula* (misprint for *turricula*) Dall and Bartsch, Mem. Cal. Acad. Sci., vol. 3, 1903, p. 285, pl. 4, fig. 14.

Shell very elongate-ovate, milk-white. Nuclear whorls smooth, obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls moderately rounded, very broadly tabulately shouldered at the summit, moderately contracted at the periphery, marked by low, feebly developed axial ribs, which are best shown at the angle of the shoulder and scarcely extend to the suture. In addition to the axial ribs, the whorls are marked by well-incised spiral lines, of which 7 occur between the sutures on the second and 9 upon the third and the penultimate turn. Periphery and base of the last whorl well rounded, the latter somewhat produced, marked by the very feeble continuation of the axial ribs and eight spiral lines. Aperture ovate, posterior angle squarely truncated; outer lip thin; columella strongly curved and reflected over the reënforcing base; provided with a strong fold at its insertion.

The type and 34 specimens (Cat. no. 168716, U.S.N.M.) were collected at San Pedro, California. The type has five post-nuclear whorls and measures: Length 4 mm., diameter 1.8 mm.

The following additional specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	Locality.	Disposition of material.
168716	35	San Pedro, California	U. S. Nat. Mus.
207128	10	.....do	Do.
	21	.....do	Oldroyd coll.
	2	.....do	Do.
168717	3	Catalina Island, California	U. S. Nat. Mus.
	2	Arch Beach, California	Univ. Cal. coll.
46176	1	Todos Santos Bay, Lower California	U. S. Nat. Mus.
105499	1	Point Abreojos, Lower California	Do.

One specimen (Cat. no. 73999, U.S.N.M.) not quite perfect, comes from Monterey, California, and is provisionally referred to the species.

Subgenus **EVALINA** Dall and Bartsch.

Evalina Dall and Bartsch, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 12.

Odostomias having feebly developed axial ribs which are usually only indicated near the summit of the whorls; spiral sculpture consisting of many fine lirations; summit of the whorls not tabulated.

Type.—*Odostomia* (*Evalina*) *americana* Dall and Bartsch.

KEY TO THE SPECIES OF THE SUBGENUS EVALINA.

Spiral lirations on the body whorl 23	*americana*, p. 180.
Spiral lirations on the body whorl 15	*intermedia*, p. 181.

ODOSTOMIA (EVALINA) AMERICANA Dall and Bartsch.

Plate 20, figs. 7, 7*a*.

Odostomia (*Evalina*) *americana* Dall and Bartsch, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 16.

Shell elongate-conic, subdiaphanous to milk-white. Nuclear whorls quite large, at least two about three-fourths obliquely immersed. Post-nuclear whorls rather broad between the sutures, well rounded, faintly shouldered at the summit, ornamented with depressed, rounded, rather broad axial ribs, about 18 of which occur upon the second, 20 on the third, and 18 upon the penultimate whorl. The ribs are best developed near the summits of the whorls and scarcely extend to the periphery. Spiral lirations low, rounded, subequal, about 12 occur between the sutures upon the third and the penultimate whorls. These spiral lirations like the axial ribs appear strongest near the summits of the whorls. Periphery and base of the last whorl well rounded, the latter ornamented by about eleven lirations, which are similar in character to those between the sutures but much less strongly expressed. Aperture rather broad, suboval, somewhat effuse anteriorly, posterior angle acute; outer lip thin; columella short, somewhat curved, strongly revolute anteriorly, having a weak oblique fold at its insertion.

The type (Cat. no. 168718, U.S.N.M.) and nine specimens come from San Pedro, California. It has five post-nuclear whorls and measures: Length 2.9 mm., diameter 1.3 mm.

The following specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	Locality.	Disposition of material.
168718	12	San Pedro, California	U. S. Nat. Mus.
168719	1	San Diego, California	Do.
168720	2	Santa Catalina Island, California	Do.
162677	2	La Jolla, California	Do.
	2	Arch Beach, California	Univ. Cal. coll.
	10	San Pedro, California	Oldroyd coll.

ODOSTOMIA (EVALINA) INTERMEDIA Carpenter.

Plate 20, fig. 6.

Dunkeria intermedia CARPENTER, Cat. Mazatlan Shells, 1856, pp. 435, 436.

Shell elongate-ovate, white. Nuclear whorls large, two and one-half, forming a depressed helicoid spire, whose axis is at right angles to that of the succeeding turns, in the first of which it is about one-fifth immersed. Post-nuclear whorls well rounded, marked by very much enfeebled indications of axial ribs, which are best shown at the summit of the whorls, and broad low spiral lirations, of which 7 occur between the sutures. Periphery and base of the last whorl well rounded, marked by eight low spiral cords, which are somewhat closer spaced about the umbilicus. Aperture oval; outer lip thin, showing the external sculpture within; columella slender and curved.

The type and another specimen were taken off *Spondylus*, at Mazatlan, Mexico. It has three post-nuclear whorls and measures: Length 1.4 mm., diameter 0.7 mm. It is on tablet 2010, Liverpool collection, British Museum.

Subgenus IOLÆA A. Adams.

Iolæa A. ADAMS, Proc. Zool. Soc., 1867, p. 310. =*Iole* A. ADAMS, Ann. Mag. Nat. Hist., 3d ser., vol. 5, 1860, p. 300; not *Iole* BLYTH, Journ. Asiat. Soc. Bengal, vol. 13, pt. 1, 1844, p. 386.

Shell umbilicated, marked by spiral cords, and axial riblets which cross the grooves between them.

Type.—*Iole scitula* A. Adams.

KEY TO THE SPECIES OF THE SUBGENUS IOLÆA.

Shell strongly shouldered.
  Shell stout, adult 2.3 mm. in diameter .... *amianta*, p. 182.
  Shell slender, adult 1 mm. in diameter .... *eucosmia*, p. 183.
Shell not shouldered .... *delicatula*, p. 183.

ODOSTOMIA (IOLÆA) AMIANTA Dall and Bartsch.

Plate 20, figs. 8, 8*a*.

Odostomia (*Iolæa*) *amianta* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 519, pl. 46, figs. 9, 9*a*.

Shell broadly conic, yellowish-white. Nucleus small, of two whorls which increase extremely rapidly in size and are obliquely placed. Post-nuclear whorls very strongly shouldered, marked by three very strong lamellar spiral keels on the first and second and four on the succeeding whorls between the sutures. The posterior keel marks the limit of the broad, sloping shoulder and is much the strongest. It is also placed a little farther apart from the next spiral keel than that is from its anterior neighbor. Base of the last whorl well rounded; ornamented by eight spiral ridges, which are less elevated and much more closely and regularly spaced than those between the sutures. The peripheral groove is about equal in width to the one anterior to the posterior keel. The entire shell is marked by fine, sublamellar, regularly spaced, retractive axial ribs, which render the spiral keels somewhat crenulated at their meeting points and break the spaces between them into small squares or oblongs. These riblets extend from the sutures to the small umbilicus. Aperture subovate, posterior angle obtuse; outer lip thin, somewhat wavy, showing the external sculpture within; columella moderately stout, somewhat curved and strongly revolute, having an oblique fold near its insertion which is barely visible when the aperture is viewed squarely; parietal wall covered by a fairly thick callus.

The type and another specimen (Cat. no. 105483, U.S.N.M.) were collected at Point Abreojos, Lower California, by Mr. Henry Hemphill. It has six post-nuclear whorls and measures: Length 4.4 mm., diameter 2.3 mm.

The following specimens have been examined:

No. of specimens.	Locality.	Collector.	Catalogue No.
1	Monterey Bay	Rev. G. W. Taylor	No. 37253 U.S.N.M.
6	Monterey, off Del Monte (12 fathoms).	S. S. Berry	S. S. Berry's coll.
1	....do	W. H. Dall	No. 168683 U.S.N.M.
1	San Pedro	Mrs. T. S. Oldroyd	No. 168684 U.S.N.M.
1	San Pedro, Long Beach	H. N. Lowe	No. 196298 U.S.N.M.
1	San Pedro, station 83	University of California	Univ. Cal. coll.
1	Off Catalina Island, station 28	....do	Do.
5	Off Catalina Island, station 30	....do	Do.
11	San Diego, station 47	....do	Do.
2	....do	F. W. Kelsey	No. 160115 U.S.N.M.
1	....do	Henry Hemphill	No. 105469 U.S.N.M.
1	Off Coronado Island, 20 fathoms; bottom temperature 58°.	U. S. B. F. station (2932)	No. 168685 U.S.N.M.
2	Point Abreojos, Lower California.	Henry Hemphill	No. 105483 U.S.N.M. (1=type).
1	Pacific Beach, California		Oldroyd coll.
2	San Pedro, California		Do.

ODOSTOMIA (IOLÆA) EUCOSMIA, new name.

=*Oscilla insculpta* (Carpenter) Keep, West Coast Shells, 1888, p. 52; not *Odostomia insculpta* De Kay, 1843.

Plate 20, figs. 10, 10*a*.

Shell elongate-conic, subdiaphanous to milk-white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last one projects. Post-nuclear whorls somewhat contracted at the periphery, very strongly slopingly shouldered at the summit, marked by three strong lamellar keels between the sutures, of which the middle one is a little nearer to its anterior neighbor than to the posterior, the latter being about as far from the summit as it is from the median keel. The deep channels between the keels and the shoulders are crossed by slender axial riblets which have a protractive slant on the shoulder and are decidedly retractive in the channels. Periphery of the last whorl marked by a keel a little weaker than those between the sutures. Base short, well rounded, narrowly umbilicated, marked by three spiral cords and a slender raised thread about the umbilicus, the channels bounding the peripheral cord and those of the base are crossed by riblets as on the spire. Aperture large; posterior angle obtuse; outer lip rendered angulated by the keels, thus showing the external sculpture within; columella slender, very strongly curved, slightly reflected, provided with a weak fold at its insertion; parietal wall covered with a weak callus.

The type (Cat. no. 106501, U.S.N.M.) comes from Point Abreojos, Lower California. It has six post-nuclear whorls and measures: Length 2.5 mm., diameter 1 mm.

The following specimens have been examined.

U.S.N.M. cat. no.	No. of specimens.	Locality.	Disposition of material.
106501	[a]1	Point Abreojos, Lower California	U. S. Nat. Mus.
105483	1	.....do	Do.
46175	1	Todos Santos Bay, Lower California	Do.
129294	32	San Pedro, California	Do.
153091	1	.....do	Do.
105469	2	San Diego, California	Do.
	2	Arch Beach, California	Univ. Cal. coll.
	27	San Pedro, California	Oldroyd coll.

[a] Type.

ODOSTOMIA (IOLÆA) DELICATULA Carpenter.

Plate 20, figs. 5, 5*a*.

Odostomia (*Evalea*) *delicatula* Carpenter, Ann. Mag. Nat. Hist., vol. 14, 1864, p. 47.

Shell very elongate, ovate, crystalline, transparent. Nuclear whorls wholly immersed in the first of the succeeding turns, above which only a portion of the last two project. Post-nuclear whorls well rounded, moderately contracted at the suture, strongly shouldered at the summit, marked by five strong, well-rounded, equal and equally spaced spiral keels between the sutures, the first of which is at the summit. The spaces separating the keels are strongly incised, a little wider than the keels and crossed by numerous, slender retractive axial riblets. Periphery of the last whorl marked by a keel. Base somewhat protracted, well rounded, minutely umbilicated, marked by seven spiral cords which grow successively weaker from the periphery to the umbilicus; spaces between the cords marked like those on the spire. Aperture large; posterior angle acute; outer lip thin, showing the external sculpture within; columella long, slender, somewhat curved, very strongly reflected, provided with a strông fold at its insertion; parietal wall covered by a thin callus.

The type (Cat. no. 4102 U. S. N. M.) comes from Cape St. Lucas, Lower California. It has four post-nuclear whorls and measures: Length 2.3 mm., diameter 0.7 mm.

Subgenus **MENESTHO** Möller.

Menestho MÖLLER, Ind. Moll. Greenl., 1842, p. 10. +*Odetta* DE FOLIN, Fonds de la Mer, 1870, p. 314. Type, *Odetta elegans* DE FOLIN. +*Jaminea* DE FOLIN, Constit. Method. de la Fam. Chemnitiziidæ, 1885, p. 15. Type, *Jaminea bilirata* DE FOLIN; not *Jaminea* BROWN, 1827. +*Jaminina* DE FOLIN, Zool. Record, vol. 22, 1885, p. 94. Type, *Jaminea bilirata* DE FOLIN.

Shell not umbilicated, marked by moderately well developed and usually equally spaced spiral cords; axial sculpture reduced to mere lines of growth which frequently appear as *very slender* raised threads in the grooves between the cords.

Type.—Turbo albulus Fabricius.

KEY TO THE SPECIES OF THE SUBGENUS MENESTHO.

- Entire surface of the shell marked by spiral cords.
  - Shell elongate-conic.
    - Shell large, adult more than 5 mm. long..............*grammatospira*, p. 185.
    - Shell small, adult less than 2.5 mm. long..................*pharcida*, p. 185.
  - Shell elongate-ovate or ovate.
    - Last whorl marked by about 40 spiral cords...................*exara*, p. 186.
    - Last whorl marked by less than 20 spiral cords.
      - Spiral cords 2 between the sutures of the last whorl....*ziziphina*, p. 186.
      - Spiral cords 3 between the sutures of the last whorl.........*recta*, p. 187.
      - Spiral cords 4 between the sutures of the last whorl.
        - Basal cords 3......................................*amilda*, p. 187.
        - Basal cords 4.
          - Shell ovate..............................*callipyrga*, p. 188.
          - Shell elongate-ovate.
            - Spiral sculpture very strong.................*farma*, p. 188.
            - Spiral sculpture very feeble.................*enora*, p. 189.
        - Basal cords 7.....................................*chilensis*, p. 189.
        - Basal cords 11......................................*fetella*, p. 189.
      - Spiral cords 6 between the sutures of the last whorl.
        - Basal cords 5...................................*hypocurta*, p. 190.
        - Basal cords 6 ....*æquisculpta*, p. 191.
        - Basal cords 8..................................*harfordensis*, p. 191.
- Base of the shell only marked by spiral cords..................*sublirulata*, p. 192.

ODOSTOMIA (MENESTHO) GRAMMATOSPIRA Dall and Bartsch.

Plate 21, figs. 7, 7*a*.

Odostomia (*Oscilla*) *grammatospira* DALL and BARTSCH, Mem. Cal. Acad. Sci., vol. 3, 1903, p. 285, pl. 1, figs. 6, 6*a*.

Shell elongate-conic, semitranslucent. Nuclear whorls small, forming a depressed helicoid spire, which is a little more than half obliquely immersed in the first of the succeeding turns. Post-nuclear whorls moderately rounded, marked by four strong, equal, and almost equally spaced spiral cords which are separated by three well-incised spiral grooves. Suture subchanneled. Periphery of the last whorl marked by a depressed cord which is not quite as strong as those between the sutures. Base somewhat attenuated, well rounded, marked by ten spiral cords which grow successively weaker and closer spaced from the periphery toward the umbilical area, disappearing altogether on the extreme anterior portion. The spaces between the spiral cords on spire and base are marked by slender axial threads. Aperture oval, effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within, rendered wavy by the keels; columella stout, reflected, reënforced by the base, provided with a weak fold at its insertion; parietal wall glazed with a faint callus.

The type (Cat. no. 161625, U.S.N.M.) was collected at Cape St. Lucas, Lower California. It has eight post-nuclear whorls and measures: Length 5.3 mm., diameter 2.1 mm.

ODOSTOMIA (MENESTHO) PHARCIDA Dall and Bartsch.

Plate 21, fig. 5.

Odostomia (*Menestho*) *pharcida* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 520, pl. 46, fig. 8. *Mumiola tenuis* DALL, Bull. Nat. Soc. Brit. Col., 1897, p. 14, pl. 1, fig. 10; not *Odostomia tenuis* CARPENTER, 1856, nor *Odostomia tenuis* JEFFREY, 1884.

Shell small, subcylindric, yellowish-white. Nuclear whorls deeply immersed, a portion of the last and the penultimate only appear when viewed from the side; this gives the shell a truncated appearance. Post-nuclear whorls moderately well rounded, rather wide between the sutures, and somewhat shouldered at the summits; ornamented by strong, low, rounded spiral cords, which are separated by moderately deep, narrow, depressed channels. Six of these cords occur upon the first, 7 upon the second to the penultimate whorl between the sutures; the posterior cord is a little broader and less elevated than the rest, while some of those on the penultimate turn show a tendency to divide—that is, a faint spiral line is apparent on the middle of some of these cords. Sutures well impressed. Periphery and base of the last whorl well rounded, the latter ornamented by eight rounded spiral cords similar to those between the sutures. The spaces between the spiral ridges on the base and between the sutures are marked by closely placed, exceedingly slender, raised axial threads. Aperture pyriform, somewhat effuse anteriorly, posterior angle acute; columella short, curved, reënforced by the attenuated base, free only at its extreme anterior end, with an oblique fold near its insertion; parietal wall covered by a thin callus.

The type (Cat. no. 107440, U.S.N.M.) was dredged by Dr. C. F. Newcombe, in 10 to 15 fathoms, at Cumshewa Inlet, Queen Charlotte Island, British Columbia. It has four post-nuclear whorls, which measure: Length 2.2 mm., diameter 0.9 mm.

ODOSTOMIA (MENESTHO) EXARA Dall and Bartsch.

Plate 21, fig. 1.

Odostomia (*Menestho*) *exara* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 521, 522, pl. 46, fig. 6.

Shell elongate-ovate, subdiaphanous. Nuclear whorls smooth, deeply immersed in the first of the succeeding turns, only a part of the last one appearing above it. Post-nuclear whorls somewhat inflated, well rounded, marked on the first whorl by 8, on the second by 12, on the third by 14, and on the penultimate between the sutures by 20 subequal and equally spaced, low, depressed spiral cords which are separated by narrower channels. Periphery and base of the last whorl inflated, sculptured like the spire by probably 20 spiral cords. In addition to the spiral sculpture the entire surface is marked by fine incremental lines which are best marked in the spaces between the cords. Aperture oval, somewhat effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella decidedly curved, reënforced by the attenuated base, free only at its anterior extremity, where it is somewhat revolute, provided with a prominent fold at its insertion which appears as the thickened inflection of the columella; parietal wall covered by a thin callus.

The type (Cat. no. 196250, U.S.N.M.) comes from Pacific Grove, Monterey, California. It has five post-nuclear whorls and measures: Length 3.9 mm., diameter 2.1 mm.

ODOSTOMIA (MENESTHO) ZIZIPHINA Carpenter.

Plate 20, fig. 2.

Parthenia ziziphina Carpenter, Cat. Mazatlan Shells, 1856, p. 416.

Shell conic, white. Nucleus mammillated. Post-nuclear whorls marked by five spiral lirations of which two appear between the sutures, one at the periphery and two on the base. Columella with an oblique fold.

To the above, Doctor Carpenter adds: "Tablet 1967 (Liverpool collection) contains a small Ziziphinus-shaped shell, very young, differing from *P. exarata* in the number and strength of spiral ridges. Length 0.65 mm., diameter 0.55 mm. One specimen was taken from *Chama* at Mazatlan, Mexico."

From an examination of the type we are able to add that it is a much worn, young, and distorted *Menestho.*

ODOSTOMIA (MENESTHO) RECTA de Folin.

Odetta recta DE FOLIN, Les Fonds de la Mer, vol. 2, 1872, pp. 167, 168.

Shell conic, ventricose, subcrystalline, robust, with straight spire. Nuclear whorls three, forming an acute apex, having their axis at right angles to that of the succeeding turn. Post-nuclear whorls four, marked by three broad, strong, somewhat rounded, spiral keels between the sutures, the spaces between which are less wide than the keels. Sutures ill defined. Last whorl almost equal to half the length of the shell. Base marked by less developed spiral cords. Aperture oval; columella provided with a strong fold.

De Folin's type, which was unfortunately crushed by him while being drawn, comes from the Margarita Island, Bay of Panama. It had four post-nuclear whorls and measured: Length 2.0 mm., diameter 1.1 mm.

ODOSTOMIA (MENESTHO) AMILDA, new species.

Plate 21, fig. 4.

Shell ovate, transparent. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last whorl projects. Post-nuclear whorls well rounded, slightly contracted at the sutures, and somewhat shouldered at the summits, the first marked by four slender equal and subequally spaced incised spiral lines; the rest are marked by a strongly incised groove a little below the summit which causes this to appear bounded by a well-rounded cord; the remainder of the whorls between the sutures show a few distantly spaced and feebly incised spiral lines and numerous very fine, decidedly retractive lines of growth. Periphery of the last whorl well rounded. Base somewhat inflated, well rounded, slightly attenuated anteriorly, marked by numerous exceedingly fine, microscopic spiral striations and three well incised equal and equally spaced lines on the anterior half. Aperture oval, somewhat effuse anteriorly; posterior angle obtuse; outer lip thin, showing the external sculpture within; columella slender, decidedly curved, somewhat reflected, reënforced by the base; provided with a strong fold at its insertion.

The type (Cat. no. 60905, U.S.N.M.) comes from San Diego, California. It has four post-nuclear whorls and measures: Length 2.6 mm., diameter 1.3 mm. Two additional specimens (Cat. no. 206907, U.S.N.M.) come from Round Island, Lower California.

ODOSTOMIA (MENESTHO) CALLIPYRGA Dall and Bartsch.

Plate 20, fig. 9.

Odostomia (*Odetta*) *callipyrga* DALL and BARTSCH, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 12. =*Odetta elegans* DE FOLIN, Fonds de la Mer, vol. 2, 1872, p. 167, pl. 6, fig. 4; not *Odostomia* (*Evalea*) *elegans* A. ADAMS, 1860, nor *Harvella* [=*Odostomia*] *elegans* H. and A. ADAMS, 1863, nor *Odostomia elegans* MONTEROSATO, 1869.

Shell oblong-ovate, somewhat ventricose, white. Nuclear whorls nearly half immersed in the first of the succeeding turns. Post-nuclear whorls somewhat inflated, moderately contracted at the periphery and moderately shouldered at the summit, marked by strong spiral cords of which 2 appear upon the first, 3 upon the second, and 4½ upon the penultimate turn between the sutures. These cords are separated by well impressed, narrow, spiral grooves which are crossed by slender axial threads. Periphery and base of the last whorl well rounded, marked by four spiral cords, similar to those on the spire, the space between which is ornamented like the grooves in the spire. Aperture oval; posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, somewhat curved and slightly reflected, provided with a fold at its insertion.

The type was collected at Margarita Island, Bay of Panama. It has four post-nuclear whorls and measures: Length 2.2 mm., diameter 1 mm.

ODOSTOMIA (MENESTHO) FARMA, new species.

Plate 20, figs. 1, 1*a*.

Shell elongate, ovate, cream-colored. Nuclear whorls at least two, marked with three slender, spiral lirations, the apex being deeply obliquely immersed in the first of the succeeding turns. The junction of the nucleus and the post-nuclear whorls is marked by a varix. Post-nuclear whorls well rounded, marked by three equal and subequally spaced spiral grooves which are crossed by slender axial riblets, the combination of grooves and ribs giving the whorls a pitted appearance. The four raised spaces bounded by the spiral grooves are finely spirally striated. Suture deeply channeled. Periphery of the last whorl marked by a spiral groove. Base of the last whorl well rounded, marked by four incised lines on the posterior two-thirds, which are equally spaced but grow successively weaker. The peripheral and first subperipheral channel are equal to those on the spire; all are rendered pitted by the slender axial riblets. Anterior third smooth. Aperture broadly oval, somewhat effuse anteriorly; posterior angle acute; outer lip thin; columella slender, curved, somewhat reflected and reënforced by the base; parietal wall covered by a thin callus.

The type (Cat. no. 206908 U.S.N.M.) comes from Catalina Island, California. It has five post-nuclear whorls and measures: Length 2.4 mm., diameter 1.2 mm.

ODOSTOMIA (MENESTHO) ENORA, new species.

Plate 21, fig. 2.

Shell elongate-ovate, milk-white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, slightly contracted at the sutures and weakly shouldered at the summits, marked between the sutures by four feebly incised spiral grooves of which the second one above the periphery is the weakest. Periphery of the last whorl somewhat inflated. Base well rounded posteriorly, somewhat attenuated anteriorly, marked by four subequal but unequally spaced incised spiral lines. Aperture oval, somewhat effuse anteriorly; posterior angle acute; outer lip thin; columella slender, slightly curved and somewhat revolute, provided with a weak fold at its insertion.

The type and two specimens (Cat. no. 207126 U.S.N.M) come from San Pedro, California. The type has six post-nuclear whorls and measures: Length 2.8 mm., diameter 1.3 mm.

ODOSTOMIA (MENESTHO) CHILENSIS, new species.

Plate 21, fig. 6.

Shell milk-white. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, slightly constricted at the suture and moderately shouldered at the summit, marked by four pitted spiral grooves, three of which divide the posterior two-thirds between the sutures into three almost equal areas, while the fourth is at the periphery. The space between the peripheral grooves and the one posterior to it is equal to one-third the space between the sutures. These grooves as well as those on the base are crossed by many slender axial riblets which break them up into pits. The raised spaces between the grooves are marked by slender lines of growth and many extremely fine spiral striations. Suture well impressed. Base of the last whorl well rounded, marked by seven pitted, well incised lines and microscopic spiral striations. Aperture broadly ovate; posterior angle acute; outer lip thin; columella slender, curved, decidedly revolute, provided with a strong oblique fold at its insertion; parietal wall covered with a thin callus.

The type (Cat. no. 109363 U.S.N.M.) was taken from the anchor of the Bureau of Fisheries steamer *Albatross* at Tome, Chile. It is a fragment consisting of the last three whorls (the nucleus and probably the first two post-nuclear whorls being lost), and measures: Length 2.3 mm., diameter 1.2 mm.

ODOSTOMIA (MENESTHO) FETELLA, new species.

Plate 21, figs. 9, 9*a*.

Shell very elongate-ovate, milk-white. Nuclear whorls small, obliquely two-thirds immersed in the first of the succeeding turns.

Post-nuclear whorls well rounded, moderately contracted at the sutures and slightly shouldered at the summit, marked by four strong flattened cords which grow successively a little weaker from the summit to the periphery, separated by narrow, deeply incised spiral grooves. Periphery of the last whorl marked by a broad, flat cord somewhat wider than the first supra-peripheral one. Base of the last whorl somewhat attenuated anteriorly, well rounded, marked by eleven equal and equally narrow, rounded, spiral cords. In addition to this sculpture, there are many very fine incised spiral lines and decidedly retractive axial lines of growth on the spire and base. Aperture broadly oval, slightly effuse anteriorly, posterior angle acute; outer lip thin, showing the external sculpture within; columella moderately strong, slightly curved, somewhat reflected, completely reënforced by the base, provided with a strong fold at its insertion; parietal wall covered by a thin callus.

The type (Cat. no. 46478, U.S.N.M.) and 124 specimens come from San Diego, California. The type has seven post-nuclear whorls and measures: Length 4.4 mm., diameter 1.8 mm.

The following specimens have been examined:

U.S.N.M. cat. no.	Number of specimens.	Locality.	Disposition of material.
126625	12	San Pedro, California	U. S. Nat. Mus.
46498	1	....do	Do.
208068	150	....do	Do.
46478	125	San Diego, California	Do.
46477	80	....do	Do.
	1	Foot of Ash street, San Diego, California.	Oldroyd Coll.
	4	San Diego, California	Univ. of Cal.
127053	10	Long Beach, California	U. S. Nat. Mus.
106520	1	San Ignacio Lagoon, Lower California	Do.

ODOSTOMIA (MENESTHO) HYPOCURTA, new species.

Plate 21, fig. 8.

Shell very elongate-ovate, bluish-white. (Nuclear whorls decollated.) Post-nuclear whorls well rounded, marked by five broad, strong, deeply incised spiral grooves, that divide the space between the sutures into raised, flattened keels, which are successively a little wider from the summit to the periphery. Periphery of the last whorl marked by a groove similar to those above. Base rather short, moderately rounded, marked by five subequal and subequally spaced spiral grooves which are a little weaker than those on the spire. The entire surface of the shell is marked by slender lines of growth, and the raised spaces between the spiral grooves are finely spirally striated. Suture strongly impressed. Aperture ? (outer lip fractured); columella strong, curved, revolute, its posterior two-thirds reënforced by the base; columellar fold not visible in the aperture. Operculum paucispiral.

The unique type (Cat. no. 168660, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 3306, off Bristol Bay, Bering Sea, Alaska, in 33 fathoms, bottom temperature 38.9. It has five post-nuclear whorls and measures: Length 4.3 mm., diameter 2.2 mm.

ODOSTOMIA (MENESTHO) ÆQUISCULPTA Carpenter.

Plate 20, figs. 3, 3*a*.

Odostomia (*Evalea*) *æquisculpta* Carpenter, Ann. Mag. Nat. Hist., 3d ser., vol. 14, 1864, pp. 46, 47=*Odostomia* (*Oscilla*) *æquisculpta* (Carpenter) Dall and Bartsch, Mem. Cal. Acad. Sci., vol. 3, 1903, p. 284, pl. 1, figs. 3, 3*a* (part).

Shell elongate-ovate, semitranslucent. Nuclear whorls deeply obliquely immersed, the tilted edge of the last only being visible. Post-nuclear whorls rounded, somewhat inflated, marked by strong, well-rounded, equal spiral keels, of which 4 occur upon the first, 5 on the second, and 6 between the sutures upon the penultimate turn, half of the peripheral one falling in the suture; here too there is a tendency in the one at the summit to become split. Periphery and base of the last whorl well rounded, marked by six spiral cords, which grow successively weaker from the periphery to the base. Spaces between the cords and spire and base narrow, marked by numerous, decidedly retractive axial threads. Suture well impressed. Aperture broadly oval, somewhat effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella strong, decidedly reflected anteriorly, reënforced by the base, provided with a small fold at its insertion; parietal wall covered with a faint callus.

The type (Cat. no. 16221, U.S.N.M.) comes from Cape St. Lucas. It has four post-nuclear whorls and measures: Length 2 mm., diameter 1.2 mm.

ODOSTOMIA (MENESTHO) HARFORDENSIS Dall and Bartsch.

Plate 21, fig. 3.

Odostomia (*Menestho*) *harfordensis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 521, pl. 46, fig. 5.

Shell elongate-ovate, bluish-white. Nuclear whorls smooth, obliquely immersed in the first of the succeeding turns, only two-thirds of the last volution projects above them. Post-nuclear whorls well rounded and somewhat inflated, marked by numerous incremental lines and five equally strong, but irregularly distributed, punctate, incised, spiral lines between the sutures. The two near the summit are placed closer to each other than any of the others, the space between the summits and the second line being about equal to the space inclosed between the first and second supra-peripheral lines. The third line falls on about the middle of the exposed portion of the whorls and is a little nearer to the second line than the one anterior to it. In addition to these five strongly incised lines there are numerous very fine and closely spaced spiral striæ which cross all parts of the surface of the shell. Periphery and base of the last turn inflated, the latter marked by lines of growth and eight strongly incised, punctate spiral lines, which are a little less strongly impressed and a little more closely spaced at the umbilical area than at the peripheral part of the base. These lines equal those of the spire in strength. Sutures constricted. Aperture very large, somewhat effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella curved, reënforced by the attenuated base and provided with a strong fold and its insertion; parietal wall covered by a thin callus.

The type (Cat. no. 196299, U.S.N.M.) was collected by Mrs. Merrihew, at Port Harford, California. It has five post-nuclear whorls and measures: Length 3.2 mm., diameter 1.8 mm.

ODOSTOMIA (MENESTHO) SUBLIRULATA Carpenter.

Plate 20, fig. 4.

Odostomia sublirulata Carpenter, Cat. Mazatlan Shells, 1856, p. 410.

Shell elongate-ovate, milk-white. (Nuclear whorls ?) Post-nuclear whorls moderately rounded, smooth between the well impressed sutures. Periphery of the last whorl somewhat angulated. Base slightly elongated, well rounded, marked by seven subequal slender, raised spiral cords which are separated by channels about one-half as wide as the cords. Aperture oval; posterior angle acute; outer lip thin, decidedly thickened within; columella straight, rather thick, somewhat reflected over the umbilical chink; provided with an oblique fold at its insertion.

The type was taken from a *Spondylus* at Mazatlan, Mexico; it is on tablet 1952, Liverpool collection, British Museum. It has five post-nuclear turns and measures: Length 2 mm., diameter 1 mm.

Subgenus EVALEA A. Adams.

Evalea A. Adams, Ann. Mag. Nat. Hist., vol. 6, 1860, p. 22; +*Ondina* de Folin, Fonds de la Mer, 1870, p. 214; type, *Ondina sulcata* de Folin; +*Auriculina* Gray, Proc. Zool. Soc., 1847, p. 159; type, *Odostomia obliqua* Alder; +*Ptychostomon* Locard, Prod. de les Moll. de France, 1886, p. 228; type, *Turbo conoideus* Brocchi.

Odostomias having the surface marked by fine incised spiral lines.

Type.—*Evalea elegans* A. Adams.

KEY TO THE SPECIES OF THE SUBGENUS EVALEA.

- Shell umbilicated.
  - Spiral sculpture consisting of incised lines only.
    - Columellar fold on the middle of the columella.........*nunivakensis*, p. 194.
    - Columellar fold decidedly posterior to the middle of the columella.
      - Spiral sculpture strong.
        - Shell thick and robust.........................*killisnooensis*, p. 195.
        - Shell thin and delicate.
          - Shell small, adult 4.1 mm. long..........*tillamookensis*, p. 195.
          - Shell larger, adult 5.5 mm. long................*esilda*, p. 196.
      - Spiral sculpture very fine.
        - Shell very broadly conic.
          - Sutures very strongly contracted................*aleutica*, p. 196.
          - Sutures not strongly contracted.............*kadiakensis*, p. 197.
        - Shell elongate-conic.
          - Summit of the whorls narrowly tabulated........*herilda*, p. 197.
          - Summit of the whorls not tabulated.
            - Sutures strongly contracted.
              - Whorls well rounded.
                - Shell very small, adult 1.6 mm. long.*tenuis*, p. 197.
                - Shell larger, adult 3 mm. long......*valdezi*, p. 198.
              - Whorls flattened in the middle..........*nemo*, p. 198.
            - Sutures not strongly contracted..................*io*, p. 199.
        - Shell ovate..*pratoma*, p. 199.
  - Spiral sculpture consisting of fine incised lines and slender raised lirations, the latter stronger than the spaces between the striations.
    - Spiral lirations confined to the base...................*septentrionalis*, p. 200.
    - Spiral lirations on spire and base.........................*capitana*, p. 200.
- Shell not umbilicated.
  - Incised spiral lines strong over the entire surface of the shell.
    - Periphery of the last whorl subangulated.
      - Spiral sculpture uniform.................................*jewetti*, p. 201.
      - Spiral sculpture consisting of fine and strong striations...*inflata*, p. 201.
    - Periphery of the last whorl well rounded.
      - Shell elongate-conic...............................*columbiana*, p. 202.
      - Shell elongate-ovate..............................*unalaskensis*, p. 203.
  - Incised spiral lines strong on the early whorls and much finer on the later turns.
    - Shell very broadly ovate.
      - Shell with incised lines and raised lirations on the last whorl.*atossa*, p. 203.
      - Shell with incised lines only.
        - Outer lip decidedly expanded anteriorly..............*obesa*, p. 203.
        - Outer lip evenly curved.........................*lucasana*, p. 204.
    - Shell elongate-ovate.
      - Shell white, semitransparent.
        - Adult shell 4.8 mm. long.......................*phanea*, p. 204.
        - Adult shell 3.3 mm. long.....................*phanella*, p. 205.
      - Shell not white nor semitransparent.
        - Incised spirals upon the second whorl 7.....*santarosana*, p. 205.
        - Incised spirals upon the second whorl 15...*tenuisculpta*, p. 206.
  - Incised spiral lines only moderately strong.
    - Periphery of the last whorl very strongly angulated........*angularis*, p. 207.
    - Periphery of the last whorl subangulated.
      - Posterior angle of aperture with weak notch.........*socorroensis*, p. 208.
      - Posterior angle without notch.
        - Adult shell 4.5 mm. long..........................*donilla*, p. 208.
        - Adult shell 3 mm. long..........................*californica*, p. 208.

- Shell not umbilicated—Continued.
  - Incised spiral lines only moderately strong—Continued.
    - Periphery of the last whorl well rounded.
      - Summits of the whorls tabulately shouldered.............*serilla*, p. 209.
      - Summit of the whorls not tabulately shouldered.
        - Shell broadly conic............................*tacomaensis*, p. 209.
        - Shell elongate-conic.
          - Shell very small, adult 3.3 mm. long.......*amchitkana*, p. 210.
          - Shell larger, more than 5 mm. long...........*stephensi*, p. 210.
        - Shell elongate-ovate................................*clessini*, p. 211.
  - Incised spiral lines exceedingly fine.
    - Periphery of the last whorl strongly angulated.
      - Shell conic...*minutissima*, p. 211.
      - Shell broadly conic...................................*raymondi*, p. 212.
    - Periphery of the last whorl subangulated.
      - Shell large, adult more than 6.5 mm. long...............*gravida*, p. 212.
      - Shell small, adult less than 4 mm. long.
        - Shell elongate-ovate.
          - Summit of the whorls subtabulated..............*notilla*, p. 213.
          - Summit of the whorls slopingly shouldered.....*movilla*, p. 213.
        - Shell ovate...*altina*, p. 214.
    - Periphery of the whorls well rounded.
      - Summit of the whorls tabulated.
        - Shell small, adult 4.5 mm. long................*profundicola*, p. 214.
        - Shell larger, adult 6.3 mm. long...............*baranoffensis*, p. 215.
      - Summit of the whorls not tabulated.
        - Shell broadly conic.
          - Columella almost straight.....................*sitkaënsis*, p. 215.
          - Columella very strongly curved.............*hagemeisteri*, p. 216.
        - Shell conic.
          - Shell minute, adult 2.2 mm. long................*resina*, p. 216.
          - Shell larger, adult 4 mm. long.................*deliciosa*, p. 216.
        - Shell slender, conic.
          - Spiral striations on base and spire uniform.......*parella*, p. 217.
          - Spiral striations stronger on the base than spire.*granadensis*, p. 217.

ODOSTOMIA (EVALEA) NUNIVAKENSIS, new species.

Plate 22, fig. 6.

Shell elongate ovate, deeply umbilicated, milk-white. Nuclear whorls small, deeply obliquely immersed in the first of the succeeding turns. Post-nuclear whorls increasing very regularly in size, rather high between the sutures, well rounded with strongly tabulated summits. Suture strongly marked. Periphery and base of last whorl well rounded, umbilicus bounded by a slender thread. Aperture elongate-ovate, posterior angle obtuse; outer lip thin; columella slender, ε-shaped, slightly revolute, free from the base, armed with a strong fold near its center. Entire surface crossed by fine lines of growth and exceedingly fine, closely spaced, wavy spiral striations.

The unique type (Cat. no. 159476, U.S.N.M.) was collected by Dr. William H. Dall at the north end of Nunivak Island, Alaska. It has five post-nuclear whorls and measures: Length 3 mm., diameter 1.6 mm. The fine spiral striations have been omitted in the drawing.

ODOSTOMIA (EVALEA) KILLISNOOENSIS, new species.

Plate 22, fig. 7.

Shell very elongate ovate, umbilicated, yellowish white. Nuclear whorls very small, obliquely, almost completely immersed in the first of the succeeding turns. Post-nuclear whorls evenly, moderately rounded, with very faintly shouldered summits, marked by numerous, fairly strong, equal and equally closely spaced, wavy, spiral striations, and fine retractive lines of growth. Periphery and base of last whorl well rounded, marked like the spire. Suture well impressed. Aperture ovate, somewhat effuse anteriorly, posterior angle acute; outer lip thin; columella very oblique, posterior two-thirds straight, and strongly reflected, anterior third strongly curved; columellar fold strong, oblique, situated at the insertion of the columella; parietal wall covered by a thin callus.

The type (Cat. no. 159457, U.S.N.M.) was collected by A. Krause, at Killisnoo, Alaska. It has six post-nuclear whorls and measures: Length 6.4 mm., diameter 3 mm. Three other specimens (Cat. no. 205214, U.S.N.M.) from the same place by the same collector were donated to the U. S. National Museum by the Berlin Museum, in whose collection three additional specimens are listed under Cat. no. 36334.

ODOSTOMIA (EVALEA) TILLAMOOKENSIS Dall and Bartsch.

Plate 22, fig. 2.

Odostomia (*Evalea*) *tillamookensis* DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 522, 523, pl. 47, fig. 1.

Shell elongate-conic, thin, yellowish white. Nuclear whorls surrounded by the first of the succeeding turns and so immersed as to give the apex a broadly truncated appearance. Post-nuclear whorls inflated, evenly strongly rounded, very slightly shouldered at the summit, separated by well-marked sutures. Periphery and base of the last whorl well rounded, the latter inflated, narrowly openly umbilicated. Entire surface marked by numerous fine, wavy, subequal, weakly incised spiral lines, of which about 35 occur between the summit and the periphery of the last whorl and about an equal number on the base. Aperture oval; outer lip thin; columella slender, evenly gently curved, and slightly revolute, free, not reënforced at the base, provided with a slender fold at its insertion, which is not visible when the aperture is viewed squarely.

The type (Cat. no. 196244, U.S.N.M.) has four post-nuclear whorls and measures: Length 4.1 mm., diameter 2.2 mm. It was dredged by the U. S. Bureau of Fisheries steamer *Albatross* at station 3346, off Tillamook, Oregon, in 786 fathoms, green mud, bottom temperature 37°.3.

ODOSTOMIA (EVALEA) ESILDA, new species.

Plate 22, fig. 1.

Shell elongate-ovate, light yellow. Nuclear whorls decollated. Post-nuclear whorls inflated, slightly rounded in the middle, more so toward the suture, and the appressed summit. Periphery and base of the last whorl well rounded, the latter narrowly umbilicated. Entire surface of spire and base marked by vertical lines of growth and numerous very fine, closely spaced, spiral lirations. Aperture large, oval, slightly effuse anteriorly; posterior angle obtuse; outer lip thin; columella slender, strongly reflected, almost closing the umbilicus; provided with a strong, deep-seated fold at its insertion.

The type (Cat. no. 206909, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2936, in 359 fathoms, temperature 49°, off San Diego, California. It has lost the nucleus and the first post-nuclear turn; the five remaining measure: Length 5.5 mm., diameter 2 mm.

ODOSTOMIA (EVALEA) ALEUTICA, new species.

Plate 22, fig. 5.

Shell broadly conic, light green. Nuclear whorls small, deeply obliquely immersed in the first of the succeeding turns. Post-nuclear whorls somewhat inflatedly rounded, with well-rounded summits. Entire surface marked by fine lines of growth and numerous very fine, closely spaced, wavy, spiral striations. Sutures strongly impressed. Periphery of the last whorl and base well rounded, the latter quite strongly inflated. Aperture broadly ovate, somewhat effuse anteriorly, posterior angle acute; outer lip broadly curved, thin; columella slender, curved, and reflected, free from the base, forming a suggestion of an umbilicus; columellar fold slender, situated a little below the insertion of the columella; parietal wall covered by a thin callus.

The above description is based upon two individuals which, together with twelve other specimens form Cat. no. 205179, U.S.N.M., and which were dredged at U. S. Bureau of Fisheries station 3336, in Iliuliuk Harbor, Bering Sea, Alaska, in 55 fathoms, bottom temperature 41°.6. The nucleus was described from a young individual and the post-nuclear whorls from an adult specimen, which has lost the nucleus and the first post-nuclear turn. The five remaining turns of this measure: Length 4.4 mm., diameter 2.8 mm. Another specimen, Cat. no. 159464, U.S.N.M., was collected in Captains Harbor, Unalaska, Alaska, in 25 fathoms on mud bottom, by Dr. W. H. Dall. Another, Cat. no. 160958, U.S.N.M., also collected by Doctor Dall, comes from Amaknak Island, Unalaska, Alaska.

ODOSTOMIA (EVALEA) KADIAKENSIS, new species.

Plate 22, fig. 9.

Shell very regularly elongate conic, umbilicated, yellowish white. (Nuclear whorls decollated.) Post-nuclear whorls moderately rounded, marked by vertical lines of growth and numerous, exceedingly fine, wavy, spiral striations. Sutures deeply impressed. Periphery of the last well rounded. Base strongly inflated, marked like the spire; umbilicus narrow, partly covered by the strongly reflected columella. Aperture ovate, effuse anteriorly, posterior angle acute; outer lip thin; columella thin, very oblique, strongly curved anteriorly and decidedly reflected, provided with a weak fold a little anterior to its insertion.

The type and another specimen (Cat. no. 159470, U.S.N.M.) were collected by Dr. W. H. Dall at Kadiak Island, Alaska. The type has six post-nuclear whorls and measures: Length 5.2 mm., diameter 2.7 mm.

ODOSTOMIA (EVALEA) HERILDA, new species.

Plate 23, fig. 8.

Shell elongate-conic, light yellow. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns. Post-nuclear whorls cylindric in outline, moderately rounded in the middle and very much so at the very strongly shouldered summit. Sutures well impressed. Periphery short, base of the last whorl well rounded, the latter narrowly umbilicated. Entire surface of spire and base marked by numerous vertical lines of growth and exceedingly fine, closely spaced, wavy spiral striations. Aperture ovate, posterior angle obtuse; outer lip thin; columella slender, somewhat sinuous, slightly reflected, provided with a deep-seated fold a little anterior to its insertion; parietal wall glazed with a thin callus.

The type (Cat. no. 206910, U.S.N.M.) was dredged off San Diego, California. It has six post-nuclear whorls and measures: Length 3.8 mm., diameter 1.8 mm.

ODOSTOMIA (EVALEA) TENUIS Carpenter.

Plate 22, fig. 3.

Odostomia tenuis Carpenter, Cat. Mazatlan Shells, 1856, p. 412; not *Odostomia tenuis* Dall and Bartsch, Mem. Cal. Acad. Sci., vol. 3, 1903, p. 281, pl. 1, fig. 14.

Shell elongate-conic, bluish-white. Nuclear whorls small, deeply obliquely immersed. Post-nuclear whorls inflated, well rounded, somewhat overhanging, strongly constricted at the suture. Periphery and base of the last whorl somewhat inflated, well rounded, strongly umbilicated. Entire surface of spire and base marked by many equal closely and equally spaced spiral striations. Aperture oval; posterior angle obtuse; outer lip thin; columella thin, curved, with a slender fold opposite the umbilicus; parietal wall covered with a thin callus, which renders the peritreme complete.

Two specimens of this species were obtained off *Spondylus*, at Mazatlan, Mexico. Tablet 1958, Liverpool collection, British Museum, contains the largest, which has five post-nuclear whorls, and measures: Length, 1.6 mm.; diameter, 0.7 mm.

ODOSTOMIA (EVALEA) VALDEZI Dall and Bartsch.

Plate 23, fig. 6.

Odostomia (Evalea) valdezi DALL and BARTSCH, Proc. U.S. Nat. Mus., vol. 33, 1907, p. 526, pl. 48, fig. 2.

Shell small, thin, very elongate-oval, subdiaphanous to milk-white, having the entire surface marked by rather strong lines of growth and numerous microscopic spiral striations. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last turn is visible. Post-nuclear turns rather high between the sutures, well rounded, with narrowly roundly shouldered summits. Periphery and base of the last turn inflated and well rounded, the latter with a very narrow umbilical chink. Aperture moderately large, oval; posterior angle acute; columella strongly curved, reinforced by the attenuated base and provided with a moderately strong fold opposite the umbilical chink.

The type has five post-nuclear whorls, and measures: Length 3 mm., diameter 1.3 mm. It and another specimen (Cat. no. 196249, U.S.N.M.) were collected by Mr. S. S. Berry, in 12 fathoms, off Del Monte, Monterey, California. Two additional specimens from the same station are in Mr. Berry's collection.

ODOSTOMIA (EVALEA) NEMO, new species.

Plate 22, fig. 8.

Shell elongate-conic, milk-white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls flattened in the middle, moderately contracted at the suture, and roundly shouldered at the summit. Suture strongly impressed. Periphery and base of the last whorl somewhat inflated, well rounded, the latter very frequently narrowly umbilicated. Entire surface of spire and base marked by vertical lines of growth and numerous exceedingly fine, spiral striations. Aperture ovate, somewhat effuse anteriorly; posterior angle acute; outer lip thin; columella thin, curved, strongly reflected, provided with a fold at its insertion; parietal wall glazed with a thin callus.

The type (Cat. no. 206911, U.S.N.M.) comes from San Diego, California. It has seven post-nuclear whorls and measures: Length 4.8 mm., diameter 2.1 mm.

Examinations of the following specimens have been made:

U.S.N.M. Cat. no.	No. of specimens.	Station No.	Locality.	Disposition of material.
126626	5	....	San Pedro, California........................	U. S. Nat. Mus.
206912	15	....	.....do..	Do.
	29	....	.....do..	Oldroyd coll.
	2	1	San Diego, California........................	Univ. Cal. coll.
206911	[a]1	....	.....do..	U. S. Nat. Mus.

[a] Type.

ODOSTOMIA (EVALEA) IO, new species.

Plate 22, fig. 4.

Odostomia tenuis Dall and Bartsch, Mem. Cal. Acad. Sci., vol. 3, 1903, p. 287, pl. 1, fig. 14; not *Odostomia tenuis* Carpenter, 1856.

Shell regularly conic, umbilicated, white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls slightly rounded, feebly contracted at the sutures, and very faintly shouldered at the summit. Sutures poorly defined. Periphery faintly angulated. Base somewhat inflated, well rounded, narrowly umbilicated. Entire surface marked by retractive lines of growth and closely spaced spiral striations. Aperture ovate, somewhat effuse anteriorly; posterior angle acute; outer lip thin; columella slender, very strongly curved, slightly revolute, provided with a strong fold at its insertion.

The type (Cat. no. 56770, U.S.N.M.) and another specimen comes from Santa Rosa Island, California. The type has six post-nuclear whorls and measures: Length 5.6 mm., diameter 2.3 mm. Cat. no. 107741, U.S.N.M., two specimens dredged in 6 fathoms, in Santa Barbara Channel. Cat. no. 15316, U.S.N.M., one specimen from San Pedro. University of California has a specimen dredged at station 30, off Santa Catalina Island.

ODOSTOMIA (EVALEA) PRATOMA, new species.

Plate 23, fig. 4.

Shell elongate-ovate, bluish-white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, strongly contracted at the sutures, with a rounded sloping shoulder at the summit. Periphery obsoletely angulated. Base well rounded with an obscure umbilical chink. Entire surface of base and spire marked by numerous, slightly retractive lines of growth and exceedingly fine, closely spaced, spiral striations. Aperture ovate; posterior angle obtuse; outer lip very thin; columella slender, strongly curved, slightly revolute, provided with a weak, deep-seated fold at its insertion.

The type (Cat. no. 206913, U.S.N.M.) and twenty-one specimens were dredged at U. S. Bureau of Fisheries station 2902, in 53 fathoms, temperature 45°, off Santa Rosa Island, California.

The type has five post-nuclear whorls and measures: Length 2.9 mm., diameter 1.4 mm. Fifteen additional specimens (Cat. no. 206914, U.S.N.M.) were dredged at U. S. Bureau of Fisheries station 2901, in 48 fathoms, temperature 55°.1, also off Santa Rosa Island.

ODOSTOMIA (EVALEA) SEPTENTRIONALIS, new species.

Plate 26, fig. 9.

Shell very elongate, ovate, thin, umbilicated, soiled yellowish white. Nuclear whorls small, smooth, very obliquely, deeply immersed in the first of the succeeding turns. Post-nuclear whorls inflated, well rounded, summits appressed, marked by fine, retractive lines of growth and numerous fine, wavy, spiral striations between the sutures and on the base. The posterior half of the base has, in addition to the above marking, three broad, low, feeble, raised, spiral threads. Umbilicus very narrow. Aperture large, very regularly oval; posterior angle obtuse, the thin outer lip bending strongly outward in a broad sweeping curve; columella long, slender, regularly curved and moderately reflected, not reënforced by the base, provided with a feeble oblique fold at its insertion; parietal wall glazed with a thin callus.

The type, Cat. no. 159462, U.S.N.M., and two additional specimens, were collected by Doctor Dall, at Unalaska, Alaska. It has five post-nuclear whorls, and measures: Length 4.3 mm., diameter 2.7 mm.

ODOSTOMIA (EVALEA) CAPITANA, new species.

Plate 26, fig. 7.

Shell elongate oval, unbilicated, light yellow. Nuclear whorls small, deeply, very obliquely immersed in the first of the succeeding turns. Post-nuclear whorls well rounded, with strongly rounded summits. Entire surface marked by fine lines of growth and exceedingly numerous, very fine, wavy, spiral striations. In addition to these markings the whorls are covered by eight very slender, subequally spaced, obsolete threads between the sutures and four which are considerably stronger and equally spaced on the base. Periphery and base of the last whorl well rounded, the latter narrowly umbilicated. Aperture rather large, broadly ovate, posterior angle acute;

outer lip thin; columella slender; very strongly curved and reflected, not reënforced by the base; parietal wall covered by a thin callus.

The type, Cat. no. 159464*b*, U.S.N.M., was collected in 25 fathoms, on sand bottom, in Captains Harbor, Unalaska, Alaska, by Dr. W. H. Dall. It has five post-nuclear whorls, and measures: Length 4.6 mm., diameter 2.5 mm. Another specimen, Cat. no. 159468, U.S.N.M., also collected by Doctor Dall, comes from 12 fathoms, mud bottom, St. Paul, Kadiak Island, Alaska.

ODOSTOMIA (EVALEA) JEWETTI Dall and Bartsch.

Plate 23, fig. 3.

Odostomia (*Evalea*) *jewetti* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp, 523, 524, pl. 47, fig. 3. =*Odostomia inflata* Carpenter, part, Ann. Mag. Nat. Hist., vol. 15, 1865, p. 394.

Shell elongate-ovate, white. Nuclear whorls very small, smooth, obliquely immersed in the first of the succeeding turns, above which only the last one is visible. Post-nuclear whorls well rounded, a little more abruptly so on the posterior third between the sutures. Summits very narrowly flattened which renders the sutures well marked. Periphery of the last whorl slightly angulated. Base slightly contracted, moderately rounded between the periphery and umbilical area, narrowly produced to reënforce the columella. Entire surface marked by numerous somewhat wavy, subequal and subequally spaced minute slender spiral lirations, of which there are about 35 between the summit and the periphery and an equal number between the periphery and the base on the last turn. Aperture large, patulous anteriorly; posterior angle acute, outer lip thin at the edge, thick within; columella curved, somewhat reflected, reënforced by the attenuated base, and provided with a strong oblique fold at its insertion.

The two cotypes (Cat. no. 15521*c*, U.S.N.M.) were collected by Colonel Jewett at Santa Barbara, California. One is a young specimen consisting of the nucleus and three post-nuclear whorls; the other has lost the nucleus and probably the first two post-nuclear turns; the five which remain measure: Length 6.1 mm., diameter 3.3 mm.

ODOSTOMIA (EVALEA) INFLATA Carpenter.

Plate 23, fig. 7.

Odostomia (*Evalea*) *inflata* (Carpenter) Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 524, pl. 47, fig. 8.

Shell ovate, white. Nuclear whorls decollated. Post-nuclear whorls inflated, gently curved over the anterior two-thirds of the whorl between the sutures and more strongly so on the posterior third, this portion forming an evenly curved shoulder. Extreme summit of the whorls slightly flattened and narrow, rendering the sutures well marked. Periphery of the last whorl subangulated. Base attenuated, rather suddenly contracted below the periphery, which gives the space between the periphery and the umbilical area a concave aspect. Entire surface marked by fine lines of growth and many fine, closely placed spiral lirations, five of which are a little stronger than the rest and divide the space between the sutures into subequal areas. There are about 30 of these threads upon the last turn between the summit and the periphery and about 60 on the base. Aperture very large, patulous anteriorly; outer lip thin at the edge but very thick within; columella decidedly curved, and revolute, reënforced to the very edge by the attenuated base, provided with a strong oblique fold at its insertion.

The type and a young individual (Cat no. 155216) were collected by J. G. Swan at Neah Bay, Washington. It has the last four whorls (the nucleus and probably the first post-nuclear turn being lost) and measures: Length 6.2 mm., diameter 3.8 mm.

ODOSTOMIA (EVALEA) COLUMBIANA Dall and Bartsch.

Plate 23, fig. 1.

Odostomia (*Evalea*) *columbiana* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 525, pl. 47, fig. 9.

Shell large, elongate-conic, white. Nuclear whorls small, vitreous, planorboid, deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution is visible. Post-nuclear whorls increasing regularly in size, well rounded, very narrowly roundly shouldered at the summits, which renders the sutures well marked. Periphery of the last whorl somewhat inflated. Base well rounded, attenuated anteriorly to reënforce the columella. Entire surface covered by numerous somewhat wavy, subequal and subequally closely placed spiral lirations, of which about 40 occur between the summit and the periphery and about an equal number on the base of the last whorl. Aperture large, decidedly patulous anteriorly; posterior angle acute; outer lip thin at the edge, very thick within; columella curved and strongly reflected, free only at its anterior extremity, provided with a strong oblique fold at its insertion.

The type and five specimens (Cat. no. 126658, U.S.N.M.) were collected by Dr. C. F. Newcombe at Victoria, Vancouver Island, British Columbia. It has six post-nuclear whorls and measures: Length 8.3 mm., diameter 4.2 mm. Three other specimens (Cat. no. 196245, U.S.N.M.) were dredged by the Bureau of Fisheries steamer *Albatross* at station 4213, off Port Townsend, Washington, in 23 to 25 fathoms, gray sand and broken shell, bottom temperature 51°. Another (Cat. no. 196246, U.S.N.M.) at stationat 4203, Fort Rupert, British Columbia, in 25 to 30 fathoms, volcanic sand and gravel and broken shell and sponge, bottom temperature 49°.1.

ODOSTOMIA (EVALEA) UNALASKENSIS, new species.

Plate 26, fig. 5.

Shell elongate-ovate, stout and strong, light yellow. (Nuclear whorls decollated.) Post-nuclear whorls flattened on their outer three-fourth, rounding suddenly to the closely appressed summit, on the posterior fourth. Entire surface of the shell marked by lines of growth and numerous equal and equally spaced, well marked spiral striations, of which about 28 occur between the sutures of the penultimate whorl. Sutures well impressed. Periphery of the last whorl somewhat angulated. Base elongated, rounded, marked like the spire. Aperture ovate, slightly effuse anteriorly, posterior angle acute; outer lip thin; columella short, strongly curved and reflected, reënforced for the greater part by the attenuated base and provided with a strong oblique fold at its insertion; parietal wall covered by a thin callus.

The unique type, Cat. no. 150464*a*, was collected by Dr. W. H. Dall, at Captains Harbor, Unalaska, Alaska. It has five and one-half post-nuclear turns and measures: Length 4.8 mm., diameter 2.8 mm.

ODOSTOMIA (EVALEA) ATOSSA Dall.

Plate 26, fig. 8.

Odostomia (*Evalea*) *atossa* DALL, Proc. U. S. Nat. Mus., vol. 34, p. 253, June, 1908.

Shell large, ovate, bluish-white. Nuclear whorls small, deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls inflated, well rounded, feebly contracted at the sutures, very weakly shouldered at the summit, marked by fine, slightly retractive lines of growth, and by 7 well-incised spiral lines on the first, 10 on the second, and 20 on the third. On the last whorl they are very feeble between the sutures, where they are replaced by four slender, spiral threads. Periphery of the last whorl inflated. Base inflated, well rounded, marked by numerous, closely spaced, fine spiral striations. Aperture large, ovate; posterior angle acute; outer lip thin; columella moderately strong, strongly curved, decidedly reflected, partly reënforced by the base and provided with a fold at its insertion.

The type (Cat. no. 110637, U.S.N.M.) and another specimen comes from San Pedro, California. The type has five post-nuclear whorls and measures: Length 6.5 mm., diameter 3.5 mm., and was collected by Mr. H. N. Lowe.

ODOSTOMIA (EVALEA) OBESA, new species.

Plate 26, fig. 4.

Shell large, ovate, yellowish-white. Nuclear whorls very small, very deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls inflated, very strongly rounded, weakly contracted at the sutures, appressed at the summit, marked by numerous, very retractive, lines of growth, and on the first three whorls by strongly incised spiral lines, of which 6 occur upon the first, 17 upon the second, 25 upon the third whorl between the sutures, while on the last whorl they are less strongly expressed and more numerous. Periphery and base of the last whorl inflated, well rounded, marked like the space between the sutures of the last whorl. Aperture broadly ovate; posterior angle acute; outer lip thin, decidedly expanded anteriorly; columella short, strongly curved, revolute, reënforced by the base and provided with a deep-seated fold at its insertion.

The type (Cat. no. 206915, U.S.N.M.) and eight specimens come from San Pedro, California. The type has five post-nuclear whorls and measures: Length 6 mm., diameter 3.5 mm.

ODOSTOMIA (EVALEA) LUCASANA, new species.

Plate 26, fig. 2.

Shell broadly oval, light yellow. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns. Post-nuclear whorls inflated, weakly contracted at the sutures, appressed at the summits, the first marked by several slender strongly incised spiral lines, the remaining with numerous very fine closely crowded, wavy, spiral striations. Suture well impressed. Periphery and base of the last whorl well inflated, marked like the space between the sutures. Aperture very large, very broadly ovate; posterior angle acute; outer lip thin; columella stout, strongly curved, reflected, reenforced by the base and provided with a strong fold at its insertion.

The type (Cat. no. 16220, U.S.N.M.) comes from Cape St. Lucas, Lower California. It has five post-nuclear whorls and measures: Length 4.7 mm., diameter 3.2 mm.

ODOSTOMIA (EVALEA) PHANEA Dall and Bartsch.

Plate 23, fig. 5.

Odostomia (*Evalea*) *phanea* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 528, pl. 48, fig. 7. =*Odostomia* (*Evalea*) *gouldi* Dall and Bartsch, Mem. Cal. Acad. Sci., 1903, p. 282, pl. 1, fig. 15, not *Odostomia* (? var.) *gouldii* Carpenter, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 30 (=*Odostomia* (*Amaura*) *gouldi* Carpenter, of the present paper).

Shell elongate-ovate, subdiaphanous to milk-white, stout and shining. Nuclear whorls small, deeply immersed in the first of the succeeding turns. Post-nuclear whorls rather high between the sutures, well rounded with scarcely an indication of a shoulder at the summit, separated by well-marked sutures. Periphery and the rather long base of the last whorl well rounded. The first two whorls are regularly closely spirally striated, in the third striation becomes enfeebled and on the penultimate decidedly obsolete, while the base is smooth. About 18 of the striæ are visible on the third turn. Aperture large, oval, somewhat effuse anteriorly; columella decidedly curved and reflected, reënforced by the attenuated base, provided with a strong oblique fold at its insertion.

The type has five post-nuclear whorls and measures: Length 4.8 mm., diameter 2.6 mm. It and another specimen (Cat. no. 46408, U.S.N.M.) belong to the Stearns collection and come from Monterey, California.

There are four other lots in the collection of the U. S. Natiomal Museum, all from Monterey. Cat. no. 46496, one specimen belongs to the Stearns collection; Cat. nos. 46474 and 46479, one specimen each collected by Doctor Canfield, and Cat. no. 159459, two collected by Doctor Dall.

ODOSTOMIA (EVALEA) PHANELLA, new species.

Plate 23, fig. 9.

Shell ovate, vitreous, translucent. Nuclear whorls deeply, very obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls inflated, slightly contracted at the suture, appressed at the summit, marked by 8 strongly incised spiral lines on the first and second and 20 upon the third, between the sutures. Suture well marked. Periphery and base of the last whorl well rounded, marked by numerous spiral striations, which are a little weaker than those between the periphery and summit of the last whorl. Aperture oval; posterior angle obtuse; outer lip thin; columella moderately strong, decidedly curved and strongly revolute, provided with a strong fold at its insertion.

The type (Cat. no. 196348, U.S.N.M.) comes from San Pedro Bay. It has four post-nuclear whorls and measures: Length 3.3 mm., diameter 1.7 mm. One specimen (Cat. no. 162676, U.S.N.M.) from La Jolla and one specimen (Cat. no. 152324, U.S.N.M.) from Ballast Point, San Diego.

ODOSTOMIA (EVALEA) SANTAROSANA, new species.

Plate 26, fig. 6.

Shell elongate-ovate, light olive. Nuclear whorls very deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls much broader at the moderately constricted suture than at the feebly shouldered summit; well rounded. The first 4 are marked by strongly incised spiral lines, of which 7 occur upon the second, 10 upon the third, and 13 upon the fourth, of which the 5 immediately below the summit are finer and closer spaced than the rest, which are equal. The entire surface of the last whorl is marked by numerous very fine, closely spaced, wavy, spiral striations. Suture well impressed. Periphery and base of the last whorl inflated and well rounded. Aperture oval; posterior angle acute; outer lip thin; columella moderately strong, decidedly curved, somewhat reflected, reënforced by the base, provided with a fold at its insertion.

The type (Cat. no. 56770 U.S.N.M.) comes from Santa Rosa Island. It has six post-nuclear whorls and measures: Length 4.9 mm., diameter 2.7 mm.

ODOSTOMIA (EVALEA) TENUISCULPTA Carpenter.

Plate 23, fig. 2.

Odostomia tenuisculpta CARPENTER, 2d Rept. Brit. Assoc. Adv. Sci., 1864, p. 659; Ann. Mag. Nat. Hist., vol. 15, 1865, p. 30. +*Odostomia straminea* CARPENTER, Journ. de Conch., vol. 13, 1865, p. 146-147. *Odostomia (Evalea) tenuisculpta* (CARPENTER), DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 527, pl. 47, fig. 6.

Shell elongate-ovate, yellowish, with the early whorls spirally lirate and the later ones only obsoletely so. Nuclear whorls small, smooth, obliquely, almost completely, immersed in the first of the succeeding turns. Post-nuclear whorls evenly well-rounded with appressed summits. The first three marked between the sutures by many subequal liræ of which there are about fifteen on the second turn. On the last two turns these lirations become quite obsolete. Periphery and base of the last whorl inflated and well rounded, marked by very feeble spiral striation and lines of growth. Aperture moderately large, oval; somewhat effuse anteriorly; posterior angle acute; outer lip thin; columella strongly curved, reënforced partly by the attenuated base, moderately reflected anteriorly, bearing a strong fold at its insertion, which appears as if it were the inflected termination of the columella.

Doctor Carpenter's type (Cat. no. 15520, U.S.N.M.) is a young individual. It was collected by J. G. Swan at Neah Bay, Washington, has three post-nuclear whorls, and measures: Length 2.3 mm., diameter 1.7 mm. The adult characters were described from two specimens (Cat. no. 46483, U.S.N.M.) collected by J. G. Swan at Neah Bay, Washington. One of these, the one figured, has six post-nuclear whorls and measures: Length 5.3 mm., diameter 2.9 mm. A specimen collected by Merrihew (Cat. no. 196247, U.S.N.M.), at Port Harford, California, bears a slender raised cord on the periphery of the whorl.

The large series of specimens in the U. S. National Museum proves conclusively that *O. straminea* Carpenter is the smooth southern representative of this species.

The U. S. National Museum has the following material:

No. of specimens.	Locality.	Collector.	Catalogue No.
1	Neah Bay, Washington	J. G. Swan	15520 U.S.N.M.
2	do	do	46483 U.S.N.M
75	Little River, Mendocino County, California.	G. W. Harford	46486 U.S.N.M.
6	Gualala, Mendocino County, California	Stearns collection	101945 U.S.N.M.
2	San Francisco Bay, California	Doctor Hewston	74006 U.S.N.M.
30	Monterey, California	Stearns collection	46482 U.S.N.M.
30	do	do	46485 U.S.N.M.
30	do	do	46493 U.S.N.M.
21	do	do	46489 U.S.N.M.
2	do	do	46491 U.S.N.M.
4	do	P. P. Carpenter	46476 U.S.N.M.
1	do	W. H. Dall	159475 U.S.N.M.
17	do	do	159477 U.S.N.M.
5	do	do	159478 U.S.N.M.
13	do	do	159479 U.S.N.M.
1	do		159480 U.S.N.M.

ODOSTOMIA (EVALEA) ANGULARIS Dall and Bartsch.

Plate 24, fig. 6.

Odostomia (*Evalea*) *angularis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 523, pl. 47, fig. 2.

Shell very regularly elongate-conic, subdiaphanous to milk-white. Nuclear whorls small, deeply obliquely immersed in the first of the succeeding turns, above which the tilted edge of the last turn only is visible. Post-nuclear whorls slightly rounded, separated by constricted sutures, marked by numerous slender, wavy, subequal and subequally closely spaced spiral striations, of which about 33 occur upon the last turn between the summit and the periphery. Periphery of the last whorl marked by a slender raised keel, decidedly angulated. Base short, moderately rounded, narrowly attenuated anteriorly to reënforce the columella, sculptured like the posterior portion of the whorls. Aperture ovate, very broad, slightly effuse anteriorly; posterior angle acute; columella very slender, evenly curved, closely appressed to the attenuated base, with a strong fold at its insertion, which is barely visible when the aperture is viewed squarely.

The type has seven post-nuclear whorls and measures: Length 5.6 mm., diameter 2.8 mm. It and four additional specimens (Cat. no. 150565, U.S.N.M.) were collected by Rev. G. W. Taylor at Nanaimo, British Columbia.

Five other lots are in the collection of the U. S. National Museum; Cat. no. 159474, one, collected by Doctor Dall at Sitka Harbor, Alaska; Cat. no. 126664, three specimens collected by Dr. C. F. Newcombe at Victoria, Vancouver Island, British Columbia; Cat. no. 43384, one specimen from Puget Sound; Cat. no. 161624, four from Port Harford, California, collected by Mrs. Merrihew; Cat. no. 196300, one, dredged by the Bureau of Fisheries steamer *Albatross* at station 3194, off the California coast, in 92 fathoms, gray sand, bottom temperature 45°.9; eighteen specimens were determined for Mr. S. S. Berry from 12 fathoms off Del Monte, Monterey Bay, California.

ODOSTOMIA (EVALEA) SOCORROENSIS, new species.

Plate 24, fig. 1.

Shell ovate, light yellow. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, moderately contracted at the sutures, appressed at the summit. Suture strongly impressed. Periphery of the last whorl feebly angulated. Base rather long, slightly rounded. Entire surface of spire and base marked by very numerous, closely crowded, exceedingly fine spiral striations. Aperture ovate; posterior angle with a decided notch; outer lip strongly arcuate, thin; columella slender, curved, slightly revolute, provided with a fold at its insertion.

The type (Cat. no. 153024, U.S.N.M.) and 84 specimens come from Socorro Island, Mexico. The type has six post-nuclear whorls and measures: Length 4.6 mm., diameter 2.2 mm.

ODOSTOMIA (EVALEA) DONILLA, new species.

Plate 24, fig. 3.

Shell broadly conic, bluish-white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, slightly contracted at the suture, appressed at the summit. Periphery of the last whorl angulated. Base slightly rounded, sloping abruptly from the periphery to the umbilical area. Suture slightly impressed. Entire surface of base and spire marked by numerous almost vertical lines of growth and many well-incised spiral striations. Aperture ovate, slightly effuse anteriorly; posterior angle acute; outer lip thin; columella strongly curved, reflected, reënforced by the base, provided with a strong fold at its insertion.

The type (Cat. no. 126626, U.S.N.M.) and eight specimens come from San Pedro, California. The type has six post-nuclear whorls and measures: Length 4.5 mm., diameter 2.2 mm. Cat. no. 152324, U.S.N.M., two specimens from Ballast Point, California. Cat. no. 46470, U.S.N.M., two specimens from Todos Santos Bay, Lower California. Cat. no. 46497, U.S.N.M., one from the same locality. Eight specimens were identified for Mrs. Oldroyd, from San Pedro Bay, California.

ODOSTOMIA (EVALEA) CALIFORNICA, new species.

Plate 24, fig. 2.

Shell small, broadly conic, bluish-white. Nuclear whorls deeply very obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects, the whole giving the spire a decidedly truncated effect. Post-nuclear whorls moderately rounded, feebly contracted at the suture, appressed at the summit, through which the preceding whorl shines, which gives the summit the effect of having a double suture. Suture moderately impressed. Periphery of the last whorl inflated, weakly angulated. Base short, sloping in a gentle curve from the periphery to the umbilical area. Entire surface of spire and base marked by decidedly retractive lines of growth and numerous well-incised spiral striations. Aperture large, ovate; posterior angle acute; outer lip thin; columella strongly curved, slightly reflected, reënforced by the narrow base, and provided with a strong deep-seated fold at its insertion.

The type (Cat. no. 206916, U.S.N.M.) comes from Ocean Beach, California. It has six post-nuclear whorls and measures: Length 3 mm., diameter 1.5 mm. Another specimen (Cat. no. 153056, U.S.N.M.) comes from the government jetty at San Diego, California.

ODOSTOMIA (EVALEA) SERILLA, new species.

Plate 24, fig. 9.

Shell elongate-conic, white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the titled edge of the last volution projects. Post-nuclear whorls well rounded, rather high between the sutures, contracted at the periphery, strongly, narrowly tabulately shouldered at the summit. Suture strongly marked. Periphery of the last whorl and the rather long base well rounded. Entire surface of spire and base marked by numerous lines of growth and well-incised spiral striations. Aperture ovate, posterior angle acute; outer lip thin; columella strongly curved, slightly revolute, provided with a fold at its insertion.

The type (Cat. no. 206917, U.S.N.M.) comes from University of California station 59, off San Diego. It has six post-nuclear whorls and measures: Length 4.8 mm., diameter 2 mm.

ODOSTOMIA (EVALEA) TACOMAENSIS Dall and Bartsch.

Plate 24, fig. 8.

Odostomia (*Evalea*) *tacomaensis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 526, pl. 47, fig. 10.

Shell ovate, yellowish. Nuclear whorls small, deeply immersed in the first of the succeeding turns. Post-nuclear whorls well rounded, faintly roundly shouldered at the extreme summits. Periphery of the last whorl rounded. Base inflated, well rounded, somewhat attenuated anteriorly. Surface covered by numerous equal and equally closely spaced slender wavy spiral striations, of which there are about forty between the summit and the periphery of the last whorl. Base marked like the space posterior to it. In addition to the spiral sculpture the entire surface of the shell is crossed by numerous fine lines of growth.

Aperture moderately large, oval, well rounded anteriorly; posterior angle acute; outer lip thin; columella curved, slightly reflected, reënforced, except at its extreme anterior end, by the attenuated base and provided with a strongly oblique fold at its insertion.

The type (Cat. no. 159267, U.S.N.M.) has five post-nuclear whorls and measures: Length 4.3 mm., diameter 2.5 mm. It was collected by Mr. Fisher at Tacoma, Washington.

ODOSTOMIA (EVALEA) AMCHITKANA, new species.

Plate 24, fig. 7.

Shell broadly conic, thin, semitranslucent, bluish-white. Nuclear whorls very obliquely immersed in the first of the succeeding turns, above which only the last half of the last turn is visible. Post-nuclear whorls well rounded, faintly shouldered at the summit, marked by fine lines of growth and numerous very fine equal and equally spaced spirally incised lines, of which there are probably more than forty between the periphery and the summit of the last turn. Sutures rendered subchanneled by the slight shoulder at the summit of the whorls. Periphery and base of the last whorl well rounded, the latter somewhat attenuated and marked like the spaces between the sutures. Aperture large, broadly pear-shaped, posterior angle obtuse; outer lip broadly recurved, thin, showing the fine external striation within; columella slender, curved, and revolute; reënforced by the attenuated base and provided with a weak fold at its insertion, which is not visible when the aperture is viewed squarely; parietal wall glazed with a thin callus.

The type (Cat. no. 161088, U.S.N.M.) and another specimen were collected by Doctor Dall at Constantine Harbor, Amchitka Island, Alaska. It has five post-nuclear whorls and measures: Length 3.3 mm., diameter 1.7 mm.

Six specimens, collected by Mrs. Kate Stephens at Bear Bay, Peril Straits, Baranoff Island, Alaska, agree well with the present species. Two of these form Cat. no. 204013, U.S.N.M.

ODOSTOMIA (EVALEA) STEPHENSI, new species.

Plate 24, fig. 5.

Shell elongate-conic, bluish-white. Nuclear whorls almost completely obliquely immersed in the first of the succeeding turns, above which only the outer edge of the last volution projects. Post-nuclear whorls rather high between the sutures, moderately rounded, ornamented by numerous fine but well incised subequal and subequally spaced spiral lines; about thirty-three of which appear between the summit and the periphery of the last whorl. Suture well marked. Periphery of last whorl well rounded. Base rather prolonged, well rounded, its entire surface marked by incised spirals like the spaces between the sutures. In addition to the spiral markings the entire surface shows fine incremental lines. Aperture elongate-oval, effuse at the junction of the outer lip and the columella; posterior angle obtuse; outer lip thin; columella stout, curved, and decidedly reflected over the reënforced base, provided with a strong oblique fold opposite the obsolete umbilical chink; parietal wall covered with a thin callus.

The type (Cat. no. 204010, U.S.N.M.) has six post-nuclear whorls and measures: Length 5.3 mm., diameter 2.6 mm. It and eight additional specimens were collected by Mrs. Kate Stephens at Bear Bay, Peril Straits, Baranoff Island, Alaska. Two in addition to the type were listed under the same number as the type in the U. S. National Museum. The rest are in Mrs. Stephens's collection.

Named for Mrs. Kate Stephens.

ODOSTOMIA (EVALEA) CLESSINI, new species.

Plate 24, fig. 4.

Shell elongate-ovate, rather thick, yellowish-white. Nuclear whorls small, very obliquely immersed in the first of the succeeding turns, above which the edge of only about two-thirds of the last nuclear whorl project. Post-nuclear turns very high between the sutures, moderately rounded, marked by lines of growth and fine, irregular and irregularly distributed incised spiral lines. Suture well impressed. Periphery and base of the last whorl well rounded, marked like the spaces between the sutures. Aperture pear-shaped, posterior angle acute; outer lip rather thick within, thin at the edge; columella short, stout, curved, reflected, reënforced by the base and provided with a strong oblique fold at its insertion; parietal wall covered by a thin callus.

The type (Cat. no. 204014, U.S.N.M.) has lost the nucleus and probably the first post-nuclear whorl. The five turns remaining measure: Length 6 mm., diameter 2.9 mm. This and another specimen listed under the same number were donated by Mrs. Kate Stephens, who collected them and seven others at Bear Bay, Peril Straits, Baranoff Island, Alaska. Five additional specimens, two of which (Cat. no. 204015, U.S.N.M.) were collected by her at Hawk Inlet, Alaska, and one more at Mole Harbor, Alaska. Two others (Cat. no. 159461, U.S.N.M.) were collected by Doctor Dall at Sitka, Alaska.

Named for T. Clessin.

ODOSTOMIA (EVALEA) MINUTISSIMA, new species.

Plate 25, fig. 4.

Shell very small, very regularly narrowly conic, bluish-white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls slightly rounded, feebly contracted at the sutures, and very narrowly tabulately shouldered at the summit. The spiral thread at the periphery and the narrow tabulated summits, which fall a little anterior to this, render the suture narrowly channeled. Periphery of the last whorl marked by a slender raised thread. Base short, well rounded, impressed at the umbilical area. Entire surface of spire and base marked by slightly protractive lines of growth and many very fine, closely spaced spiral striations. Aperture rhomboidal, posterior angle obtuse; outer lip thin; columella slender, curved, slightly revolute, provided with a strong fold at its insertion.

The type (Cat. no. 206918, U.S.N.M.) and five specimens come from San Diego, California. The type has six post-nuclear whorls and measures: Length 3.1 mm., diameter 1.3 mm. Two additional specimens (Cat. no. 206919, U.S.N.M.) come from San Hipolito Point, Lower California, and three more (Cat. no. 105484, U.S.N.M.) from Point Abreojos, Lower California.

ODOSTOMIA (EVALEA) RAYMONDI, new species.

Plate 25, fig. 9.

Shell regularly conic, milk-white. Nuclear whorls very obliquely deeply immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects, which gives the spire a decidedly truncated aspect. Post-nuclear whorls well rounded, slightly shouldered at the summit, marked by a raised spiral thread at the decidedly angulated periphery. The summits of the whorls fall a little anterior to the periphery, and cause the sutures to appear subchanneled. Base short, well rounded. Entire surface of base and spire marked by strongly retractive lines of growth and numerous closely spaced spiral striations. Aperture oval; posterior angle acute; outer lip thin; columella curved, reflected, reënforced by the base and provided with a moderately strong fold at its insertion.

The type (Cat. no. 206920, U.S.N.M.) was dredged by the University of California, at station 30, off Catalina Island. It has six post-nuclear whorls and measures: Length 3.6 mm., diameter 1.6 mm. A topotype is in the University of California collection.

This species resembles *Odostomia* (*Evalea*) *minutissima*, but is much broader with a stronger peripheral keel and with an oval instead of rhomboidal aperture.

Named for Prof. William J. Raymond.

ODOSTOMIA (EVALEA) GRAVIDA Gould.

Plate 25, fig. 7.

Odostomia gravida GOULD, Proc. Bost. Soc. Nat. Hist., vol. 6, 1852, p. 376.

Shell large, broadly conic, milk-white, shining. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls moderately rounded, somewhat shouldered at the summit, marked by fine lines of growth and numerous, very fine, closely spaced spiral striations. Sutures well impressed. Periphery of the last whorl somewhat angulated. Base sloping from the periphery to the umbilical area, but slightly rounded. Aperture ovate; posterior angle obtuse; outer lip fractured; columella short, strong, curved, and revolute, provided with a strong fold at its insertion; parietal wall covered with a weak callus.

The type (Cat. no. 44, State Museum, Albany, New York (original no. 24), A 31, 10) was collected at Santa Barbara, California. It has seven post-nuclear whorls and measures: Length 6.6 mm., diameter 3 mm.

ODOSTOMIA (EVALEA) NOTILLA, new species.

Plate 25, fig. 6.

Shell very elongate, ovate, yellowish-white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, feebly contracted at the sutures, narrowly subtabulately shouldered at the summit. Suture strongly marked. Periphery of the last whorl marked by a low raised cord, which renders it decidedly angulated. Base short, well rounded, somewhat pinched in at the umbilical area. Entire surface of spire and base marked by almost vertical lines of growth and numerous very fine, well incised, spiral striations. Aperture ovate, posterior angle acute; outer lip thin; columella slender, slightly curved, provided with a fold at its insertion; parietal wall covered with a thick callus.

The type (Cat. no. 206921, U.S.N.M.) was dredged by the University of California, at station 30, off Catalina Island, California. It has five post-nuclear whorls and measures: Length 2.7 mm., diameter 1.3 mm. The topotype is in the University of California.

ODOSTOMIA (EVALEA) MOVILLA, new species,

Plate 25, fig. 1.

Shell elongate-ovate, white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls feebly rounded in the middle, strongly so at the slopingly shouldered summit, and moderately contracted at the suture. Periphery weakly angulated. Base rather long, moderately rounded, sloping gently from the periphery to the umbilical area. Suture well impressed. Entire surface of spire and base marked by fine retractive lines of growth and numerous very fine closely spaced wavy spiral striations. Aperture broadly oval, posterior angle obtuse; outer lip thin; columella slender, very strongly curved, very oblique, provided with a deep seated fold at its insertion; parietal wall covered with a thin callus.

The type (Cat. no. 206922, U.S.N.M.) and seven specimens were dredged at U. S. Bureau of Fisheries, station 2936, in 359 fathoms, temperature 49°, off San Diego, California. It has five post-nuclear whorls and measures: Length 3.6 mm., diameter 1.7 mm.

ODOSTOMIA (EVALEA) ALTINA, new species.

Plate 25, fig. 2.

Shell ovate, white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, feebly contracted at the suture, appressed at the summit. Suture slightly impressed. Periphery obscurely angulated. Base well rounded. Entire surface marked by slightly retractive lines of growth and exceedingly fine spiral striations. Aperture ovate, posterior angle acute; outer lip thin; columella strongly curved, decidedly revolute, provided with a strong fold at its insertion.

The type (Cat. no. 206923, U.S.N.M.) and two additional specimens were dredged at U. S. Bureau of Fisheries, station 2936, in 359 fathoms, temperature 49°, off San Diego, California. The type has five post-nuclear whorls and measures: Length 3 mm., diameter 1.5 mm.

ODOSTOMIA (EVALEA) PROFUNDICOLA, new species.

Plate 25, fig. 8.

Shell turrited, milk-white. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls moderately rounded, slightly contracted at the sutures, broadly tabulately shouldered at the summit. Periphery and base of the last whorl somewhat inflated, strongly rounded. Entire surface of spire and base marked by numerous vertical lines of growth and exceedingly fine microscopic, closely spaced, spiral striations. Aperture very large, ovate; posterior angle obtuse; outer lip thin; columella slender, somewhat twisted, oblique, slightly revolute, provided with a deep-seated fold.

The type (Cat. no. 206924, U.S.N.M.) and eight specimens were dredged at U. S. Bureau of Fisheries, station 2936, in 359 fathoms, temperature 49°, off San Diego, California. The type has six post-nuclear whorls and measures: Length 4.5 mm., diameter 2 mm. The University of California has a specimen dredged at station 13, off Point Vincente.

ODOSTOMIA (EVALEA) BARANOFFENSIS, new species.

Plate 25, fig. 3.

Shell elongate-ovate, rather stout, yellowish-white. Nuclear whorls obliquely immersed in the first of the succeeding turns, the outer edge of the last turn only being visible. Post-nuclear whorls well rounded, with a narrow, tabulate shoulder at the summit. Suture rendered subchanneled by the shoulder at the summit of the whorls. Periphery and base of the last whorl inflated, well rounded, the latter with a depressed pit, but no perforation in the umbilical area. Entire surface marked by lines of growth and very fine spiral striations. Aperture ear-shaped; posterior angle obtuse; outer lip thick within, thin at the edge; columella very stout, twisted and obliquely revolute, armed with a thick oblique fold opposite the umbilical chink; parietal wall covered by a thin callus.

The type (Cat. no. 204011, U.S.N.M.) has six post-nuclear whorls and measures: Length 6.3 mm., diameter 2.8 mm. It and two additional specimens were collected by Mrs. Kate Stephens at Bear Bay, Peril Straits, Baranoff Island, Alaska. Two additional specimens were obtained by the same collector at Mole Harbor, Admiralty Island, Alaska; one of them forms Cat. no. 204012, U.S.N.M.

ODOSTOMIA (EVALEA) SITKAENSIS Clessin.

Plate 26, fig. 3.

Odostomia sitkaensis Clessin, Martini Chemnitz Conch. Cab., 2d ed., Pyramidellidæ, 1900, p. 121, vol. 30, fig. 1. *Odostomia* (*Evalea*) *sitkaensis* Clessin, Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1906, p. 360, pl. 17, fig. 8.

Shell elongate-conic, very regular in outline, yellowish white, shining. Nuclear whorls almost completely immersed in the first of the succeeding volutions. Post-nuclear whorls moderately rounded, rather high between the sutures, slightly shouldered at the summits, marked by many fine lines of growth and numerous fine wavy spiral striations; the latter are more regularly developed and distributed than the lines of growth. (Our figure does not show the spiral markings.) The periphery of the last whorl marks the greatest diameter of the shell. The base, though rather long, falls off rather abruptly at the periphery, then tapers gradually to the anterior end of the columella; it is marked like the spaces between the sutures. Aperture large, oval; posterior angle acute, outer lip decidedly curved, almost patulous, thin; columella long, slender, gently curved, and somewhat reflected, provided with a moderately strong, oblique fold near its insertion; parietal wall without callus.

The Berlin collection contains two specimens of this species, No. 26232, which were collected by F. Schmidt, at Sitka, Alaska. We have described and figured the most perfect of the two, which we consider Clessin's type. This specimen measures: Length 4 mm., diameter 2 mm. Clessin's figure is worthless.

ODOSTOMIA (EVALEA) HAGEMEISTERI, new species.

Plate 26, fig. 1.

Shell small, elongate ovate, yellowish white. Nuclear whorls small, almost completely immersed in the first of the succeeding turns. Post-nuclear whorls moderately well rounded, with rounded summits, marked by retractive lines of growth and many fine, closely placed spiral striations. Suture well impressed. Periphery of last whorl well rounded. Base well rounded, marked like the spire. Aperture ovate, posterior angle acute; outer lip thick within, thin at edge; columella very short, very strongly curved, somewhat revolute, reënforced by the attenuated base and provided with a strong fold at its insertion.

The unique type (Cat. no. 159469, U.S.N.M.) was collected by Dr. William H. Dall at low-water mark at Hagemeister Island, Bering Sea. It has five post-nuclear whorls and measures: Length 4.4 mm., diameter 2.4 mm. The fine spiral striations have been omitted in the drawing.

ODOSTOMIA (EVALEA) RESINA, new species.

Plate 27, fig. 6.

Shell very small, vitreous, transparent. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls inflated, strongly rounded, decidedly contracted at the suture, and appressed at the summit, where the preceding whorl is reflected through it, and gives the summit the false appearance of having a spiral cord. Suture strongly constricted. Periphery and base of the last whorl well rounded. Entire surface of the shell marked by lines of growth which are of varying strength, and numerous closely spaced, exceedingly fine, spiral striations. Aperture ovate, posterior angle acute; outer lip thin, showing the external sculpture within; columella slender, strongly curved, slightly revolute, reënforced by the base, provided with a fold at its insertion.

The type (Cat. no. 206925, U.S.N.M.) comes from Arch Beach, California. It has five post-nuclear whorls and measures: Length 2.2 mm., diameter 1 mm.

ODOSTOMIA (EVALEA) DELICIOSA Dall and Bartsch.

Plate 25, fig. 5.

Odostomia (*Evalea*) *deliciosa* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 525, 526, pl. 47, fig. 5.

Shell small, elongate-conic, translucent to milk-white. Nuclear whorls small, deeply immersed in the first of the succeeding turns, above which only a portion of the last turn is visible. Post-nuclear whorls moderately rounded, very weakly roundly shouldered at the summit, separated by a strongly marked suture; a narrow band appears about the summit showing its junction with the preceding turn. Periphery and base of the last whorl inflated and well rounded. Entire surface of base and spire marked by very fine lines of growth and numerous microscopic wavy spiral striations. Aperture rather large, somewhat effuse anteriorly; posterior angle acute; outer lip thin; columella rather stout, strongly curved, and revolute, reënforced by the attenuated base, and covered with a strong fold at its insertion. This fold can be seen through the transparent shell as a quite strong lamella on the pillar of the turns.

The type (Cat. no. 46492, U.S.N.M.) is from Monterey, has 6½ post-nuclear whorls and measures: Length 4 mm., diameter 1.9 mm. Another specimen (Cat. no. 196301, U.S.N.M.) also comes from Monterey, California.

ODOSTOMIA (EVALEA) PARELLA, new species.

Plate 27, fig. 5.

Shell elongate-conic, pale yellow. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle between the sutures, strongly contracted at the periphery, moderately roundly shouldered at the summit, marked by rather strong lines of growth and exceedingly fine, closely spaced, microscopic spiral striations. Suture strongly contracted. Periphery and base of the last whorl well rounded, the latter slightly inflated, marked like the spire. Aperture ovate; posterior angle acute; outer lip thin; columella very strongly curved, somewhat revolute, reënforced by the base, provided with a fold at its insertion.

The type (Cat. no. 206926, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2808, in 634 fathoms, temperature 39.9°, near the Galapagos Islands. It has the last five whorls remaining which measure: Length 3.7 mm., diameter 1.6 mm. It has lost the nucleus and probably the first two succeeding turns.

ODOSTOMIA (EVALEA) GRANADENSIS, new species.

Plate 27, fig. 4.

Shell very slender, ovate-conic, white, with a narrow, faint yellow band a little posterior to the middle between the sutures. Nuclear whorls very deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls flattened, slightly contracted at the sutures, and feebly shouldered at the summits. Periphery and base of the last whorl well rounded, the latter somewhat attenuated. Entire surface of spire and base marked by many fine, closely spaced, wavy spiral striations, which are considerably stronger on the base than between the sutures. Aperture ovate; posterior angle acute; outer lip thin; columella short, slender, curved and feebly revolute, provided with a fold at its insertion.

The type (Cat. no. 206927, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2794, off Panama Bay, in 62 fathoms, sand, temperature 59°.5. It has five post-nuclear whorls and measures: Length 2.7 mm., diameter 1 mm.

Subgenus AMAURA Möller.

Amaura Möller, Index Moll. Groenlandica, 1842, p. 7.

Very large, usually inflated Odostomias, the sculpture of which consists of very fine lines of growth and still finer wavy closely placed spiral striations.

Type.—*Amaura candida* Möller.

KEY TO THE SPECIES OF THE SUBGENUS AMAURA.

- Shell umbilicated.
  - Shell very large, adult more than 10 mm. long.
    - Shell very elongate-ovate........*lastra*, p. 219.
    - Shell broadly ovate........*kennerleyi*, p. 219.
  - Shell less than 10 mm. long.
    - Shell ovate.
      - Summit of the whorls concavely shouldered........*elsa*, p. 220.
      - Summit of the whorls narrowly flatly shouldered........*beringi*, p. 220.
    - Shell very elongate-ovate.
      - Umbilicus rather wide.
        - Summit of the whorls with a faint shoulder........*satura*, p. 221.
        - Summit of the whorls with a strongly tabulated shoulder........*farallonensis*, p. 221.
      - Umbilicus very narrow.
        - Summit of the whorls appressed........*sillana*, p. 222.
        - Summit of the whorls shouldered.
          - Shoulder concave........*talpa*, p. 222.
          - Shoulder narrowly tabulated.
            - Whorls strongly contracted at the suture....*krausei*, p. 223.
            - Whorls not strongly contracted at the suture.
              - Adult shell 7.8 mm. long........*orcia*, p. 223.
              - Adult shell 6.1 mm. long........*gouldi*, p. 224.
- Shell not umbilicated.
  - Shell very large, adult more than 12 mm. long........*arctica*, p. 224.
  - Shell less than 10 mm. long.
    - Shell elongate-ovate.
      - Summit of the whorls appressed........*avellana*, p. 225.
      - Summit of the whorls not appressed.
        - Columella free for its entire length.
          - Shell finely spirally lirate........*moratora*, p. 225.
          - Shell not finely spirally lirate.
        - Shell large and robust, adult 9.3 mm. long........*pesa*, p. 226.
        - Shell of medium size, not robust, adult 7.5 mm. long..*nota*, p. 226.
      - Columella free only in its anterior half........*iliuliukensis*, p. 227.

Shell not umbilicated—Continued.
  Shell less than 10 mm. long—Continued.
    Shell ovate.
      Summit of the whorls appressed .... *nuciformis*, p. 227.
      Summit of the whorls tabulated.
      Adult shell more than 9 mm. long .... *canfieldi*, p. 228.
      Adult shell less than 7 mm. long .... *subturrita*, p. 228.
    Shell very broadly ovate .... *martensi*, p. 229.

ODOSTOMIA (AMAURA) LASTRA, new species.

Plate 28, fig. 7.

Shell thin, large, elongate-ovate, tapering very regularly to an acute point, narrowly umbilicated. Nuclear whorls very small, deeply obliquely immersed in the first of the succeeding whorls, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, moderately constricted at the sutures and narrowly shouldered at the summit, marked by numerous slender wavy spiral striations and fine lines of growth which give the surface a somewhat malleated appearance. Periphery and base of the last whorl strongly rounded, the latter narrowly umbilicated, marked like the spire. Aperture large, broadly oval, slightly effuse anteriorly; posterior angle acute; outer lip thin; columella slender, very oblique, almost straight and somewhat reflected; parietal wall glazed with a thin callus.

The type (Cat. no. 206928, U.S.N.M.) was dredged at U. S. Bureau of Fisheries station 2917, in 90 fathoms, temperature 49°.1, off southern California. It has eight post-nuclear whorls and measures: Length 13.6 mm., diameter 7 mm. Other specimens examined are as follows: One, Cat. no. 170794, U.S.N.M., from Santa Catalina Channel, California; one dredged by University of California at station 21 (3), off Santa Catalina Island, University of California coll.; one dredged by University of California at station 30, off Santa Catalina Island, University of California coll.; one dredged by University of California at station 81, off San Diego, University of California coll.

ODOSTOMIA (AMAURA) KENNERLEYI Dall and Bartsch.

Plate 28, fig. 8.

Odostomia (Amaura) kennerleyi DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 529, pl. 48, figs. 8, 8*a*.

Shell large, very thin, broadly conic, umbilicated, yellowish-white; marked by subobsolete, subequal, and subequally spaced spiral wrinkles, about fifteen of which may be seen on the body and base of the last whorl. In addition to these wrinkles, many faint, closely placed spiral and vertical striae are present. Nuclear whorls small, about two and one-half, forming a depressed spire which is deeply immersed, the axis of which is almost at right angles to the axis of the latter whorls. Post-nuclear whorls very wide, inflated, well rounded, faintly shouldered at the summit. Suture well marked, simple. Periphery and base of the last whorl inflated, well rounded, the latter decidedly contracted and narrowly umbilicated. Aperture large, suboval, somewhat effuse anteriorly; posterior angle obtuse; outer lip thin; columella straight, obliquely inserted, revolute, not reënforced by the base, with an oblique weak fold near its insertion; parietal wall apparently without a callus.

The type (Cat. no. 150564, U.S.N.M.) was collected by Rev. G. W. Taylor at Nanaimo, British Columbia. It has six post-nuclear whorls which measure: Length 10.2 mm., diameter 6 mm.

Two other specimens (Cat. no. 4493*b*, U.S.N.M.) were collected by Doctor Kennerley at Puget Sound, Washington, and another (Cat. no. 129121) by Prof. O. B. Johnson, at Seattle, Washington.

ODOSTOMIA (AMAURA) ELSA, new species.

Plate 29, fig. 1.

Shell ovate, umbilicated, yellowish white. Nuclear whorls very small, deeply immersed in the first of the succeeding turns. Post-nuclear whorls well rounded, with strongly concave summits, forming deeply channeled sutures, marked by slightly retractive lines of growth, and exceedingly fine, closely placed, wavy spiral striations. Periphery of the last whorl well rounded. Base short, inflated, moderately umbilicated, marked like the spire. Aperture ovate, posterior angle obtuse; columella curved,. slightly reflected, not reënforced by the base, provided with an oblique fold some little distance anterior to its insertion; parietal wall covered by a thin callus.

The type (Cat. no. 55811, U.S.N.M.) was collected by W. J. Fisher at Kadiak Island, Alaska. It has six post-nuclear whorls, and measures: Length 6.1 mm., diameter 3.6 mm.

ODOSTOMIA (AMAURA) BERINGI Dall.

Plate 27, fig. 8.

Odostomia beringi Dall, Am. Journ. Conch., vol. 7, 1872, p. 117.

Shell ovate, umbilicated, bluish white. Nuclear whorls small, obliquely immersed in the first of the succeeding turns. Post-nuclear whorls moderately rounded, slightly shouldered at the summits, marked by retractive lines of growth. Periphery of the last whorl well rounded. Base short, strongly umbilicated. Aperture oval; posterior angle obtuse, outer lip thin; columella strong, sinuous, decidedly reflected, provided with a strong fold a little below its insertion. Parietal wall glazed by a callus.

The type (Cat. no. 169456, U.S.N.M.) was collected by Doctor Dall at St. Michael, Norton Sound, Alaska. It has five post-nuclear whorls, and measures: Length 5.7 mm., diameter 2.8 mm.

ODOSTOMIA (AMAURA) SATURA Carpenter.

Plate 27, fig. 1.

Odostomia satura Carpenter, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 29. +var. *pupiformis* Carpenter, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 29. =*Odostomia* (*Amaura*) *satura* (Carpenter) Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 529–530, pl. 48, figs. 5, 5*a*.

Shell of medium size, broadly conic, white. Nuclear whorls at least two, forming a depressed spire, the axis of which is almost at a right angle to the axis of the later whorls, and which is deeply, somewhat obliquely immersed in the first post-nuclear turn. Post-nuclear whorls moderately well rounded, faintly shouldered at the summit, marked all over by irregular rough, low, tumescenses, which simulate obsolete vertical ribs. Sutures simple, well marked. Periphery of the last whorl well rounded. Base quite short, decidedly rounded, and umbilicated. Umbilicus partly covered by the revolute columella. Aperture large, very broadly oval, somewhat effuse anteriorly; posterior angle obtuse; outer lip thick; columella moderately strong, oblique, decidedly curved, with a decided oblique fold, situated considerably anterior to its insertion; parietal wall covered by a fairly thick callus.

The type (Cat. no. 15520, U.S.N.M.) was collected by J. G. Swan at Neah Bay, Washington. It has five and one-half whorls which measure: Length 6.4 mm., diameter 3.5 mm.

The specimen upon which Doctor Carpenter fixed the name *pupiformis* (Cat. no. 15520*a*, U.S.N.M.), collected by J. G. Swan at Neah Bay, Washington, is not worthy of a varietal name. It is a freak, having the spire less elevated, which is, perhaps, due to some injury received at an early date, evidence of which seems present. It agrees perfectly in every detail with the type of *satura* excepting the shape of the spire.

ODOSTOMIA (AMAURA) FARALLONENSIS, new species.

Plate 27, fig. 7.

Shell very elongate-ovate, deeply umbilicated, light yellow. Nuclear whorls very deeply immersed. Post-nuclear whorls very slightly rounded in the middle between the sutures, more strongly so near the anterior end and toward the summit. Summit strongly narrowly tabulate. Periphery of the last whorl inflated. Base very strongly suddenly rounded, widely and deeply umbilicated. Entire surface marked by numerous fine, closely spaced, spiral striations. Aperture broadly ovate, posterior angle obtuse, outer lip thin; columella very slender, strongly curved, revolute, provided with a deep fold a little below its insertion; parietal wall glazed with a thin callus.

The type (Cat. no. 168827 U.S.N.M.) was dredged by the U. S. Bureau of Fisheries station 3180, in 24 fathoms, temp. 50.°7, off the Farallones Islands, California. It has five post-nuclear whorls, and measures: Length 5.5 mm., diameter 2.7 mm.

ODOSTOMIA (AMAURA) SILLANA, new species.

Plate 28, fig. 9.

Shell short, conic, yellowish white. (Nuclear whorls eroded.) Post-nuclear whorls well rounded, slightly overhanging. Summits appressed, marked by almost vertical lines of growth and numerous closely spaced, wavy, microscopic, spiral striations. Suture well marked. Periphery of the last whorl well rounded. Base rather short, inflated, narrowly umbilicated and marked like the spire. Aperture broadly ovate, somewhat effuse anteriorly. Posterior angle acute; outer lip thin, strongly curved in the middle; columella slender, strongly curved and reflected anteriorly, provided with a weak fold near its insertion; parietal wall glazed by a thin callus.

The type (Cat. no. 168809, U.S.N.M.), collected by Doctor Dall west of Amaknak Island, Unalaska, in 60 fathoms, on stony bottom. It has five and one-half post-nuclear whorls, and measures: Length 5.6 mm., diameter 2.8 mm.

ODOSTOMIA (AMAURA) TALPA, new species.

Plate 27, fig. 9.

Shell stout, rough, very broadly conic, narrowly umbilicated. Nuclear whorls small, deeply obliquely immersed in the first post-nuclear turn. Post-nuclear whorls with quite strong concavely shouldered summits, the rest well rounded (usually showing decided erosion marks which coincide largely with the lines of growth). The parts bearing the original surface show traces of exceedingly fine spiral striations. Periphery and base of the last whorl rather inflated, well rounded, the latter narrowly umbilicated, marked like the spire. Aperture broadly oval, posterior angle obtuse; outer lip rather thick, columella stout, thick, somewhat flexuose and reflected, provided with a strong fold a little anterior to the umbilicus; parietal wall covered by a thin callus.

The type (Cat. no. 204027, U.S.N.M.) has seven post-nuclear whorls, and measures: Length 8 mm., diameter 3.8 mm. It and two other specimens were collected by Mrs. Kate Stephens at Mole Harbor, Alaska. Two additional specimens (Cat. no. 159472 U.S.N.M.) were dredged by Doctor Dall in 12 fathoms in Sitka Harbor, Alaska.

ODOSTOMIA (AMAURA) KRAUSEI Clessin.

Plate 29, fig. 5.

Odostomia krausei CLESSIN, Mart. Chem. Conch. Cab., 2d ed., Pyramid., 1900, p. 115, pl. 28, fig. 1. *Odostomia* (*Amaura*) *krausei* (CLESSIN) DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 362, pl. 23, fig. 2.

Shell elongate-conic, thick and heavy, rough through erosion, yellowish white. (Nuclear whorls decollated in the type, judging from the pit in the apex they are probably deeply, obliquely immersed.) Post-nuclear whorls only moderately rounded, somewhat shouldered at the summit (surface decidedly eroded). Periphery and base of the last whorl well rounded, the latter with a minute umbilical chink. Aperture auricular, somewhat effuse anteriorly, posterior angle scarcely acute; outer lip very thick, reflexed, pillar with a broad, strong, oblique fold, a little anterior to its insertion; parietal wall covered by a thick callus.

The type has six post-nuclear whorls, and measures: Length 9.9 mm., diameter 5 mm. It was collected by Krause at Killisnoo, which is in Alaska, and not in Japan, as stated by Clessin. The registration number of his type in the Berlin Museum is also wrong; the specimen described and figured by him is Cat. no. 36335, and not Cat. no. 36336, as given in his account of the species.

The U. S. National Museum has two lots, one specimen (Cat. no. 159454, U.S.N.M.) from Killisnoo, collected by Krause, and another (Cat. no. 159471, U.S.N.M.) from Kadiak.

The last is in better state of preservation than the rest of the material examined; from it we learn that the whorls are strongly rounded, subtabulate at the summit and decidedly constricted at the sutures, marked by fine, slightly retractive lines of growth and exceedingly fine, closely spaced, microscopic spiral striations. Our figure is made from this specimen, which has seven post-nuclear whorls, which measure: Length 8.8 mm., diameter 4 mm.

ODOSTOMIA (AMAURA) ORCIA, new species.

Plate 27, fig. 3.

Shell elongate-ovate, narrowly umbilicated, yellowish-white. Nuclear whorls small, deeply immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls well rounded, moderately contracted at the sutures, and narrowly shouldered at the summit, marked by numerous closely spaced, wavy, spiral striations. Periphery and base of the last whorl inflated, well rounded, the latter narrowly umbilicated, both marked by spiral sculpture like that of the spire. Aperture moderately large, ovate, posterior angle obtuse; outer lip thin; columella strongly curved and somewhat reflected, provided with a strong fold a little posterior to its insertion; parietal wall covered with a thin callus.

The type (Cat. no. 206929, U.S.N.M.) comes from Santa Rosa Island. It has six post-nuclear whorls and measures: Length 7.7 mm., diameter 3.8 mm.

ODOSTOMIA (AMAURA) GOULDI Carpenter.

Plate 27, fig. 2.

Odostomia (*Amaura*) *gouldii* (Carpenter) Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 531, 532, pl. 48, fig. 4. *Odostomia* (? var.) *gouldii* Carpenter, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 29.

Shell of medium size, elongate-conic, yellowish-white, the exterior surface marked by irregular tumescences, giving it a much worn appearance. Nuclear whorls three, deeply immersed, having their axis at about a right angle to the axis of the succeeding turns. Post-nuclear whorls moderately well rounded, faintly shouldered at the summit. Sutures simple, well marked. Periphery and base of the last whorl well rounded, the latter somewhat elongated. Umbilicus faint. Aperture quite large, pyriform, posterior angle obtuse, outer lip moderately thick; columella very oblique, fairly strong, revolute, with a strong fold somewhat anterior to its insertion; parietal wall covered with a fairly strong callus.

The type (Cat. no. 22821, U.S.N.M.) comes from Neah Bay, Washington. It has six post-nuclear whorls, and measures: Length 6.1 mm., diameter 3.1 mm.

ODOSTOMIA (AMAURA) ARCTICA, new species.

Plate 28, fig. 5.

Shell large, elongate-ovate, straw yellow. (Nuclear whorls decollated.) Post-nuclear turns well rounded, with subtabulate summits, marked by lines of growth and numerous fine, closely-placed, wavy, spiral striations. Periphery well rounded. Suture well impressed. Base rather elongated, marked like the space between the sutures. Aperture pear-shaped, rather narrow posteriorly, and somewhat effuse anteriorly, posterior angle rendered obtuse by the tabulation; outer lip thin; columella short, curved, slightly reflected, reënforced by the attenuated base and provided with a weak fold at its insertion; parietal wall covered by a thin translucent callus.

The type has lost the early whorls; the last four and one-half only remain, which measure: Length 12.4 mm., diameter 6.5 mm.

It and another specimen are entered as Cat. no. 168766, U.S.N.M., and were collected at U. S. Fish Commission station 3305, southwest of Hagemeister Island, Bering Sea, in 23 fathoms, at a bottom temperature of 41°.8. Another specimen (Cat. no. 109454, U.S.N.M.) comes from Sea Horse Islands, Arctic Ocean. Two lots (Cat. no. 168807, U.S.N.M.) four specimens collected in 15 fathoms off Icy Cape, Arctic Ocean, and a single specimen (Cat. no. 168808, U.S.N.M.), in 7 to 15 fathoms, from the same locality. Eight additional specimens were dredged at U. S. Fish Commission station 3306, off Bristol Bay, Bering Sea, in 33 fathoms, bottom temperature 38°.9.

ODOSTOMIA (AMAURA) AVELLANA Carpenter.

Plate 28, fig. 3.

Odostomia (? var.) *avellana* CARPENTER, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 30. *Odostomia* (*Amaura*) *nuciformis avellana* (CARPENTER) DALL and BARTSCH, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 530, 531, pl. 48, figs. 1, 1*a*.

Shell large, elongate-ovate, yellowish to milk white. Nuclear whorls deeply vertically immersed; only part of the last volution is visible when viewed from above, their axis evidently being at a right angle to the axis of the later whorls. Post-nuclear whorls increasing rapidly in size, early ones well rounded, later ones less so, their summits being closely appressed to the preceding whorl. Suture well impressed, simple. Periphery and base of the last whorl well rounded, the latter somewhat elongated. Aperture large, ovate, somewhat effuse anteriorly, milk-white within; posterior angle acute; outer lip thin at the edge, thick within; columella short curved; reënforced partly by the attenuated base, having a strong oblique fold at its insertion; parietal wall covered by a moderately strong callus.

The type (Cat. no. 15517*b*, U.S.N.M.) comes from Neah Bay, Washington. It has five post-nuclear whorls and measures: Length 8.3 mm., diameter 4.3 mm.

ODOSTOMIA (AMAURA) MORATORA, new species.

Plate 30, fig. 7.

Shell elongate-ovate, imperforate, yellowish white. Nuclear whorls decollated. Post-nuclear whorls strongly rounded, moderately contracted at the sutures, narrowly flatly shouldered at the summit; marked by strong lines of growth and subobsolete fine spiral lirations which lend the surface a somewhat reticulated appearance. The spaces between the feeble lirations are marked by numerous very fine spiral striations. Periphery of the last whorl and base inflated, strongly rounded, marked like the spire. Aperture oval, posterior angle obtuse; outer lip thin; columella stout, oblique, revolute, provided with a strong fold a little below its insertion.

The type (Cat. no. 207261, U.S.N.M.) was dredged by the U. S. Bureau of Fisheries at station 3164, rocky bottom, temperature 48°.5, in 61 fathoms, off Point Reyes, California. It has six post-nuclear whorls and measures: Length 9.5 mm., diameter 4.9 mm.

ODOSTOMIA (AMAURA) PESA, new species.

Plate 29, fig. 2.

Shell elongate-ovate, very coarse and heavy. Nuclear whorls small, deeply, obliquely immersed in the first of the succeeding turns. Post-nuclear whorls rather high between the sutures, well rounded with narrowly tabulate summits, marked by somewhat retractive lines of growth and numerous, closely placed, wavy spiral striations. Sutures well marked. Periphery of the last whorl well rounded, marked like the spire. Base slightly prolonged, well rounded. Aperture ovate, somewhat effuse anteriorly; posterior angle acute; outer lip very heavy; columella strong, flexuose with a strong, broad fold somewhat anterior to its insertion; parietal wall covered by a thin callus.

The type (Cat. no. 157458, U.S.N.M.) was collected by Doctor Dall at Kadiak Island, Alaska. It has six post-nuclear whorls, and measures: Length 9.3 mm., diameter 4.4 mm.

ODOSTOMIA (AMAURA) NOTA, new species.

Plate 28, fig. 6.

Shell very elongate-ovate, light yellow. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls moderately rounded, slightly contracted at the sutures, narrowly tabulately shouldered at the summits, marked by numerous closely spaced, wavy spiral striations. Periphery and base of the last whorl somewhat inflated, well rounded, marked like the spire. Aperture ovate, posterior angle obtuse; outer lip thin; columella short, strongly curved, reflected and provided with a moderately strong fold a little anterior to its insertion.

The type (Cat. no. 46490, U.S.N.M.) and sixteen specimens comes from San Diego, California. The type has seven post-nuclear whorls and measures: Length 7.5 mm., diameter 3.5 mm.

The following specimens have been examined:

U.S.N.M. cat. no.	Number of specimens.	U. S. B. F. station.	Locality.	Depth, fathoms.	Temperature, degrees.	Disposition of material.
206930	9	2901	Off Santa Rosa Island, California.	48	55.1	U. S. Nat. Mus.
168804	4		San Pedro, California			Do.
	3		do.			Oldroyd coll.
	1		do.			Berry coll.
	8	[a] 20	Off Newport, California			Univ. Cal. coll.
	5	[a] 32	Off Catalina Island, California.			Do.
	5	[a] 34	do.			Do.
	3	[a] 36	do.			Do.
	2		Pacific Beach, California			Kelsey coll.
	3	[a] 47	San Diego, California			Univ. Cal. coll.
46490	17		do.			U. S. Nat. Mus.

[a] University of California station.

ODOSTOMIA (AMAURA) ILIULIUKENSIS, new species.

Plate 29, fig. 4.

Shell very elongate-conic, heavy, very light yellow. Nuclear whorls small, almost completely obliquely immersed in the first of the succeeding turns. Post-nuclear whorls rather high between the sutures, well rounded with narrowly tabulate summits, marked by fine, retractive lines of growth and numerous fine, closely spaced spiral striations. Suture well marked. Periphery of the last whorl well rounded. Base rather prolonged, evenly rounded, marked like the spire. Aperture pear-shaped, posterior angle obtuse; outer lip thin at the edge, thickened within; columella twisted, strongly curved anteriorly, where it is also reflected and reënforced by the base, provided with a low fold at its insertion; parietal wall glazed by a thin callus.

The type (Cat. no. 159463, U.S.N.M.) was collected by Doctor Dall in 6 fathoms, on mud bottom, off Iliuliuk Village, Captains Bay, Unalaska, Alaska. It has six and one-half post-nuclear whorls, and measures: Length 9.5 mm., diameter 4.6 mm. Ten additional specimens (Cat. no. 159453, U.S.N.M.) were collected by Doctor Dall, at Eider Cove, Captains Bay, Unalaska, in 25 fathoms on sand bottom. Another specimen (Cat. no. 159465, U.S.N.M.), likewise collected by Doctor Dall, bears the legend Unalaska, without specific locality.

ODOSTOMIA (AMAURA) NUCIFORMIS Carpenter.

Plate 28, fig. 1.

Odostomia nuciformis Carpenter, Ann. Mag. Nat. Hist., 3d ser., vol. 15, 1865, p. 30. *Odostomia* (*Amaura*) *nuciformis* (Carpenter) Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 530, pl. 48, figs. 3, 3*a*.

Shell large, shortly ovate, yellowish to milk-white. Nuclear whorls deeply immersed; only half of the last turn is seen in tilted position when viewed from above. Post-nuclear whorls increasing rapidly in size, well rounded, having their summits closely appressed to the preceding whorl. Suture moderately well impressed. Periphery and base of the last whorl well rounded. Aperture rather large, ovate, white within; posterior angle acute; outer lip moderately thin at the edge, thicker within; columella short, strongly curved, with a strong oblique fold at its insertion; reënforced by the attenuated base; parietal wall covered by a thin callus.

The type (Cat. no. 15517*a*, U.S.N.M.) comes from Neah Bay, Washington. It has five post-nuclear whorls which measure: Length 7.7 mm., diameter 4.4 mm.

ODOSTOMIA (AMAURA) CANFIELDI Dall.

Plate 28, fig. 2.

Odostomia (*Amaura*) *canfieldi* Dall, Nautilus, vol. 31, 1908, p. 131. =*Odostomia* (*Amaura*) *montereyensis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 531, pl. 48, figs. 6, 6*a;* not *Odostomia* (*Chrysallida*) *montereyensis* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 516, pl.46, fig. 4.

Shell large, similar in form to *O.* (*A.*) *avellana;* white, shining. Nuclear whorls 3, helicoid, quite elevated, deeply immersed in the first of the succeeding whorls, having their axis at a right angle to the axis of the later whorls. Post-nuclear whorls well rounded, with a beveled shoulder at the summits. Suture well marked, simple. Periphery and base of the last whorl well rounded and inflated, the latter somewhat elongated. Aperture subovate, somewhat effuse anteriorly; posterior angle acute; outer lip thin at the edge, thick within; columella curved and somewhat revolute, having a prominent oblique fold near its insertion; parietal wall covered by a thin callus.

The type (Cat. no. 46473, U.S.N.M.) is from Monterey, California. It has six post-nuclear whorls which measure: Length 9.6 mm., diameter 5.1 mm.

In addition to these, others have been named for the University of California from Monterey; for Mr. S. S. Berry from 12 fathoms off Del Monte, Monterey Bay; for Mrs. Oldroyd from San Pedro, and for Mr. Kelsey from San Diego, California.

This species resembles *O.* (*A.*) *avellana* Carpenter, but differs markedly from that form by having the summits of the whorls shouldered.

ODOSTOMIA (AMAURA) SUBTURRITA, new species.

Plate 28, fig. 4.

Shell ovate, light yellow. Nuclear whorls small, deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls flattened, scarcely at all contracted at the sutures, with a very broad tabulate summit, crossed by numerous spiral striations, which are a little darker colored than the general surface of the shell. Periphery and base of the last whorl somewhat inflated, well rounded, marked like the space between the sutures. Aperture large, oblong-ovate, slightly effuse anteriorly; posterior angle very obtuse; outer lip thick within, thin at the edge; columella curved, somewhat twisted, strongly reflected, provided with a strong fold a little anterior to its insertion.

The type (Cat. no. 168801, U.S.N.M.) and nine specimens come from San Pedro, California. The type has six post-nuclear whorls and measures: Length 6.9 mm., diameter 3.5 mm.

The following additional specimens have been examined:

U.S.N.M. cat. no.	No. of specimens.	U.S.B.F. station.	Locality.	Depth, fathoms.	Disposition of material.
	2	....	Santa Barbara, California..........	....	Univ. Cal. coll.
206931	1	2901	Off Santa Rosa Island, California..	48	U. S. Nat. Mus.
	1	[a] 12	Redondo, California..........	....	Univ. Cal. coll.
	8	....	San Pedro, California..........	....	Oldroyd coll.
206932	5	....	.....do..........	....	U. S. Nat. Mus.
105535	3	....	San Diego, California..........	....	Do.
206933	2	....	San Diego (Pacific Beach). California.	....	Do.
46472	1	....	Todos Santos Bay, Lower California.	....	Do.

[a] University of California.

ODOSTOMIA (AMAURA) MARTENSI Dall and Bartsch.

Plate 29, fig. 3.

Odostomia (*Amaura*) *martensi* Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 361, pl. 15, fig. 5. *Odostomia curta* Clessin, Mart. Chem. Conch. Cab., 1900, p. 116, pl. 28, fig. 3; not *Odostomia curtum* Deshayes, An. Sans. Vert. Paris Basin, 1862, p. 551, pl. 19, figs. 9-11.

Shell ovoid, heavy, yellowish white. Nuclear whorls small, almost completely immersed in the first of the succeeding volutions. Post-nuclear whorls increasing regularly and rapidly in size, inflated, subtabulately shouldered at the summit, marked by numerous fine lines of growth and equally abundant, closely placed, wavy spiral striations. These lines of growth and spiral markings give the surface a finely reticulated appearance when viewed under high magnifications. (We have omitted this sculpture in our drawing, which should be considered as an outline sketch only.) Periphery and base of the last whorl decidedly rounded and inflated, marked like the space between the sutures. Aperture large, suboval, slightly effuse anteriorly, posterior angle acute; outer lip sharp at the edge but thick within; columella very strong, curved, reënforced by the body whorl, from which the slightly reflected edge is separated only by a narrow line. A strong oblique fold, not completely visible when the aperture is viewed squarely, is located a little anterior to the insertion of the columella.

The type has five post-nuclear whorls and measures: Length 5.3 mm., diameter 3.1 mm. Clessin gives the diameter as 1.3, evidently a transposition. He also cites the registration number as 36336, while it should be 36335. His figure almost represents this species. The type comes from Killisnoo, Alaska, not Japan, as cited by Clessin.

Subgenus SCALENOSTOMA Deshayes.

Scalenostoma Deshayes, Cat. Moll. Ile de la Réunion, 1863, pp. 58-60.

Smooth Odostomias having a strong peripheral keel.

Type.—*Scalenostoma carinatum* Deshayes.

KEY TO THE SPECIES OF THE SUBGENUS SCALENOSTOMA.

Aperture irregularly ovate	*rangii.*
Aperture regularly broadly ovate	*dotella.*

ODOSTOMIA (SCALENOSTOMA) DOTELLA, new species.

Plate 30, fig. 5.

Shell elongate-conic, vitreous, translucent. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution projects. Post-nuclear whorls flattened, very strongly angulated at the periphery where they are much wider than at the appressed summit. The summit of the succeeding turns falls very much anterior to the angulated periphery and gives to the whorls a decided overhanging appearance. Base well rounded. Entire surface of spire and base marked by numerous, almost vertical lines of growth and very many exceedingly fine spiral striations. Aperture broadly ovate, posterior angle acute; outer lip thin; angulated at the periphery; columella slender, very strongly curved and slightly revolute.

The type (Cat. no. 206934, U.S.N.M.) and six specimens were dredged at U. S. Bureau of Fisheries stations 2826-2828, in 9½ to 10 fathoms, off Ceralvo Island, Gulf of California. The type has six post-nuclear whorls and measures: Length 2.3 mm., diameter 0.8 mm. Cat. no. 206935, U.S.N.M., contains six specimens from U. S. Bureau of Fisheries station 2823, off La Paz, in 26½ fathoms, broken shell bottom, off Cacachitas, Gulf of California. These and the next are provisionally referred here. One specimen from U. S. Bureau of Fisheries station 2822, in 21 fathoms, off La Paz, Mexico (Cat. no. 206936, U.S.N.M.).

ODOSTOMIA (SCALENOSTOMA) RANGII de Folin.

Plate 30, fig. 2.

Chemnitzia rangii DE FOLIN, Les Méléagrinicoles, 1867, p. 61, pl. 6, fig. 1.

Shell elongated-turrited, white. Nuclear whorls small. Post-nuclear whorls flat in the middle, somewhat excurved at the summit which is closely appressed against the preceding whorl immediately anterior to the keel. Periphery of the last whorl marked by a very strong acute lamellar keel. Base moderately well rounded. Aperture irregularly ovate, posterior angle acute; outer lip thin, strongly angulated at the periphery; columella curved and reflected; parietal wall covered with a thin callus.

De Folin's type comes from the Bay of Panama or Negritos Island. It has twelve post-nuclear whorls and measures: Length 2.7 mm., diameter 1.1 mm.

Subgenus HEIDA Dall and Bartsch.

Heida Dall and Bartsch, Proc. Biol. Soc. Wash., vol. 17, 1904, p. 13.

Shell without axial or spiral sculpture beyond mere lines of growth and exceedingly fine spiral striations; peritreme continuous, aperture rissoid.

Type.—*Syrnola caloosaensis* Dall.

ODOSTOMIA (HEIDA) PANAMENSIS Clessin.

Plate 30, fig. 6.

Odostomia panamensis Clessin, Mart. Chem. Conch. Cab., 2d ed., Pyramidellidæ, 1900, p. 120, pl. 28, fig. 9. *Odostomia* (*Heida*) *panamensis* (Clessin) Dall and Bartsch, Proc. U. S. Nat. Mus., vol. 30, 1906, pp. 365, 366, pl. 26, fig. 4.

Shell small, heavy, elongate-ovate, whorls increasing regularly in size, milk white, shining. Nuclear whorls small, almost completely obliquely immersed in the first of the succeeding volutions. Postnuclear whorls moderately and evenly rounded, of porcellanous texture, without any apparent marking, separated by a well marked suture. Periphery of the last whorl full and rounded. Base inflated, well rounded. Aperture small, decidedly rissoid, almost channeled anteriorly, posterior angle acute; outer lip decidedly curved backward anteriorly, very thick within but beveled to form a sharp edge; columella extremely short, somewhat reflected, and connected posteriorly with the very strong parietal callus, which is fully as thick as the edge of the outer lip and connects with it at the posterior angle of the aperture, thus forming a complete peristome. A prominent oblique fold is present on and a little anterior to the insertion of the columella.

There are two specimens of this species in the Berlin collection from Panama. We have considered the best preserved individual, which evidently served Clessin for his description and figure as his type, and have here rediagnosed and figured it. It has six post-nuclear whorls and measures: Length 3.1 mm., diameter 1.5 mm.

Clessin for some unaccountable reason changed the characters of the aperture in the above-cited figure to harmonize with the typical *Odostomia* aperture. He seems to have failed entirely in recognizing the peculiarities of the present species.

O. (*Heida*) *panamensis* Clessin, represents the first member of this subgenus on the west coast of America; several additional species inhabit the southeast coast.

Subgenus ODOSTOMIA s. s.

Odostomia Fleming, Edinburgh Encyc., vol. 7, pt. 1, 1817, p. 76. =*Odontostomia* Jeffreys, Mal. and Conch. Mag., 1839, p. 34, same type. =*Turritostomia* Sacco, I Moll. del Piemonte e della Liguria, 1892, p. 41, same type.

Shell without axial or spiral sculpture excepting microscopic lines of growth.

Type.—Turbo plicatus Montagu.

KEY TO THE SPECIES OF THE SUBGENUS ODOSTOMIA.

- Periphery of the last whorl angulated.
  - Whorls overhanging .... *farella*, p. 232.
  - Whorls not overhanging.
    - Whorls well rounded .... *dinella*, p. 232.
    - Whorls flattened .... *mammillata*, p. 233.
- Periphery of the last whorl well rounded .... *coronadoensis*, p. 233.

ODOSTOMIA (ODOSTOMIA) FARELLA, new species.

Plate 30, fig. 4.

Shell small, white. (Nuclear whorls decollated.) Post-nuclear whorls flattened in the middle, slightly rounded at the appressed summit, strongly contracted at the suture, where they are decidedly overhanging. Suture well impressed. Periphery angulated. Base well rounded, narrowly umbilicated. Entire surface of spire and base marked by fine lines of growth only. Aperture ovate, posterior angle acute; outer lip thin; columella very oblique posteriorly, decidedly curved anteriorly, strongly reflected, provided with a weak fold somewhat anterior to its insertion; parietal wall covered with a thin callus.

The type (Cat. no. 206937, U.S.N.M.) was dredged off Long Beach, California. It has five post-nuclear whorls and measures: Length 2.5 mm., diameter 1.2 mm.

ODOSTOMIA (ODOSTOMIA) DINELLA, new species.

Plate 30, fig. 1.

Shell small, ovate, vitreous, semitransparent. (Nuclear whorls decollated.) Post-nuclear whorls forming a spire with almost straight sides, slightly rounded, feebly contracted at the suture, appressed at the summit, marked only by lines of growth. Suture well impressed. Periphery of the last whorl obscurely angulated. Base somewhat inflated, well rounded, narrowly umbilicated, marked like the spire. Aperture ovate, posterior angle acute; outer lip thin; columella slender, almost vertical, slightly revolute, provided with a weak fold at its insertion; parietal wall covered with a strong callus.

The type (Cat. no. 206938, U.S.N.M.) was dredged near Redondo, California. It has five post-nuclear whorls and measures: Length 2.2 mm., diameter 1.2 mm.

ODOSTOMIA (ODOSTOMIA) CORONADOENSIS, new species.

Plate 30, fig. 3.

Shell minute, ovate, vitreous. Nuclear whorls almost vertically deeply immersed in the first of the succeeding turns, above which the tilted edge of the last volution projects. Post-nuclear whorls well rounded, slightly contracted at the sutures, with a well rounded shoulder at the summit, marked by retractive lines of growth only. Suture well impressed. Periphery and base of the last whorl slightly inflated, well rounded, marked like the spire. Aperture ovate; posterior angle acute; outer lip thin; columella slender, strongly curved, slightly revolute, reënforced by the base, provided with a weak, deep-seated fold; parietal wall covered with a thin callus.

The type (Cat. no. 206939, U.S.N.M.) was dredged by Mr. F. W. Kelsey in 35 fathoms, off Coronado Beach, San Diego, California. It has four post-nuclear whorls and measures: Length 1.7 mm., diameter 0.8 mm. Two topotypes are in Mr. Kelsey's collection.

ODOSTOMIA (ODOSTOMIA) MAMMILLATA Carpenter.

Plate 30, fig. 8.

Odostomia mammillata CARPENTER, Cat. Mazatlan Shells, 1856, p. 412.

Shell ovate, milk-white. Nuclear whorls large, oblique, two-thirds immersed in the first of the succeeding turns. Post-nuclear whorls decidedly flattened, rather high between the sutures, smooth. Suture well impressed. Periphery marked by a slender, raised cord, which renders it angulated. Base rather short, slightly inflated immediately below the umbilical area. Aperture broadly oval; posterior angle acute; outer lip thin, angulated at the periphery; columella short, slender, strongly curved and slightly reflected; parietal wall covered by a strong callus.

A single specimen of this species is known. It is on tablet 1957, Liverpool collection, British Museum, and was taken off *Chama* at Mazatlan, Mexico. It has four post-nuclear whorls and measures: Length 1.1 mm., diameter 0.7 mm.

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Copy of a camera lucida sketch by Dr. Carpenter.

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Copy of a camera lucida sketch by Dr. Carpenter.

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Copy of a camera lucida sketch by Dr. Carpenter.
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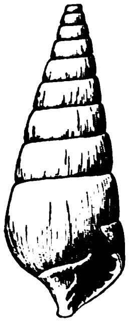
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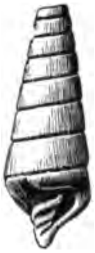
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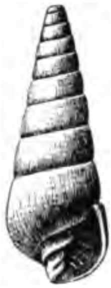
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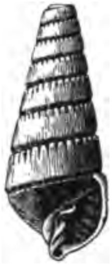
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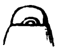
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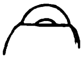
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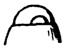
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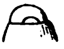
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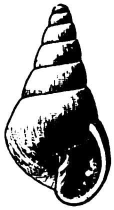
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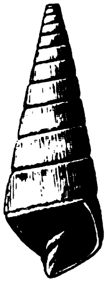
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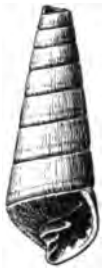
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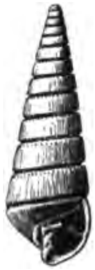
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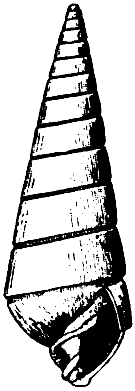
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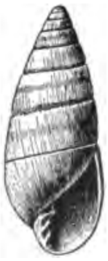
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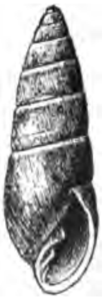
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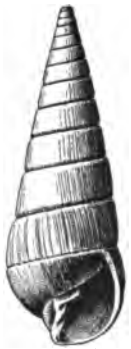
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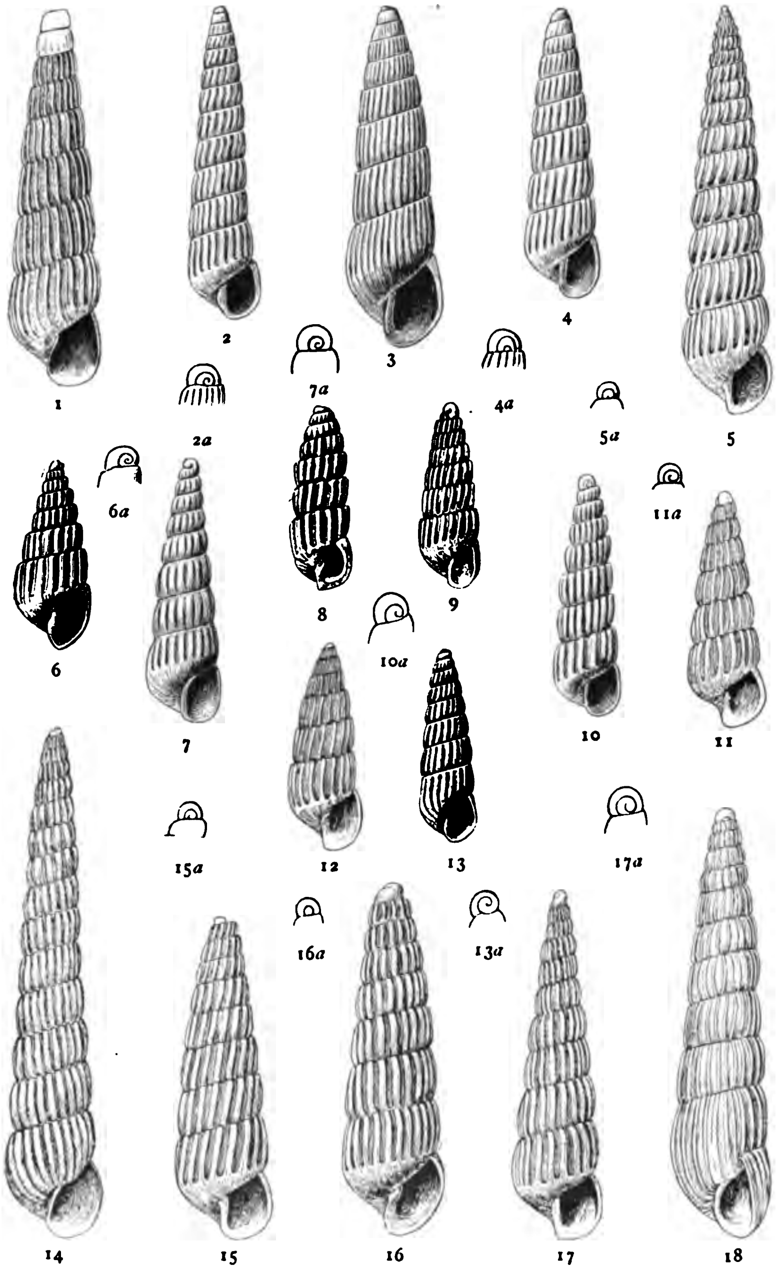

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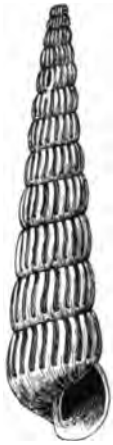
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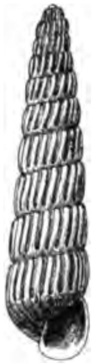
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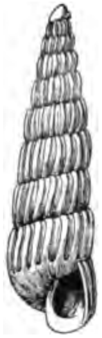
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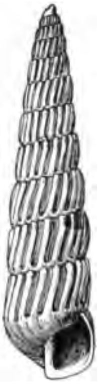
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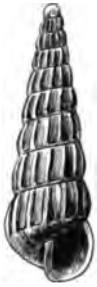
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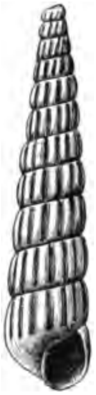
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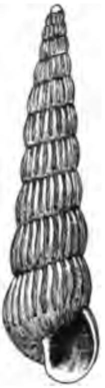
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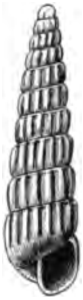
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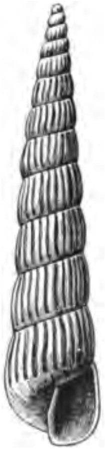
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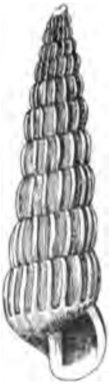
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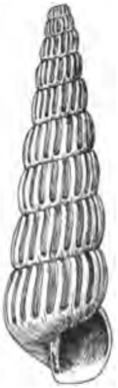
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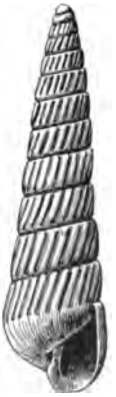
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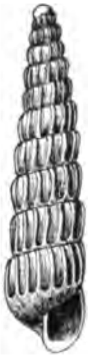
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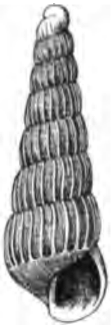
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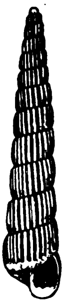
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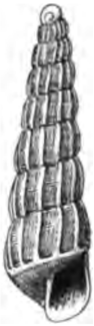
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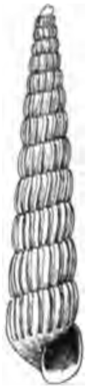
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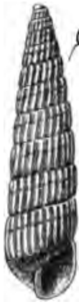
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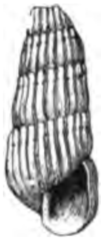
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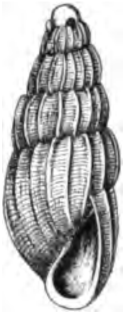
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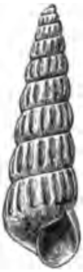
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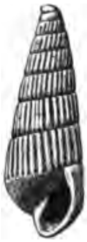
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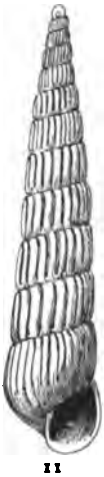
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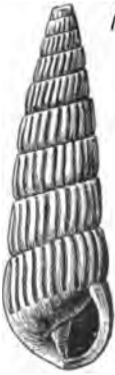
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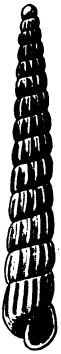
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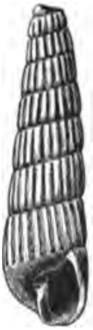
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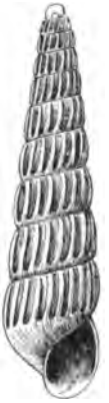
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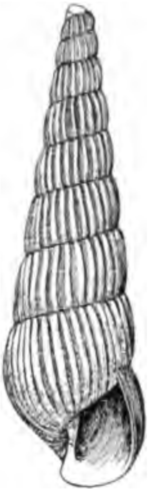
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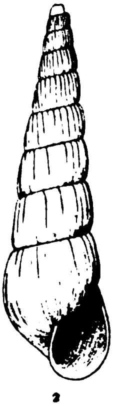
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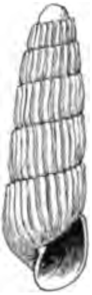
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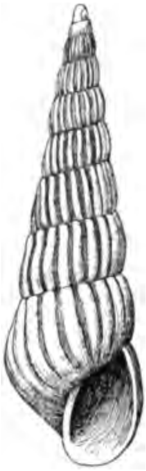
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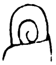
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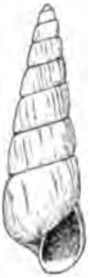
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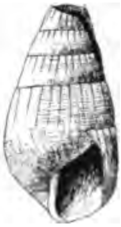
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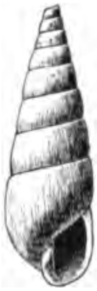
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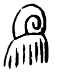
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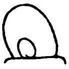
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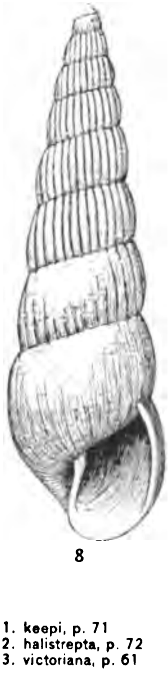
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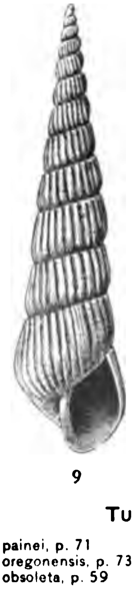
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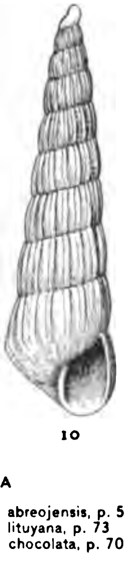
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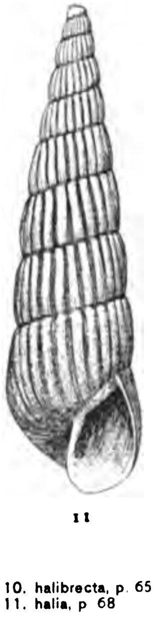
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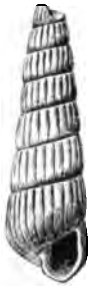
TURBONILLA

1. keepi, p. 71
2. halistrepta, p. 72
3. victoriana, p. 61
4. painei, p. 71
5. oregonensis, p. 73
6. obsoleta, p. 59
7. abreojensis, p. 59
8. lituyana, p. 73
9. chocolata, p. 70
10. halibrecta, p. 65
11. halia, p. 68



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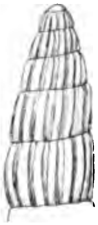

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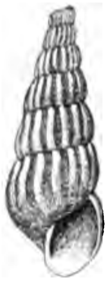

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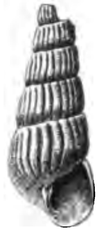

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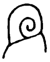

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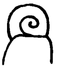

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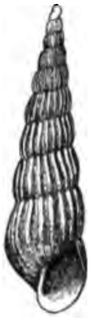

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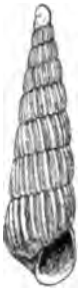

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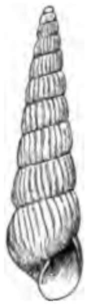

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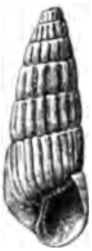

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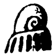

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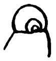

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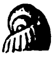

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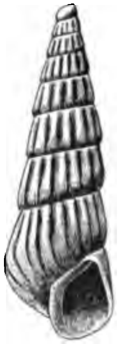

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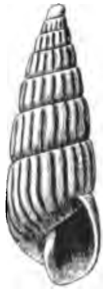

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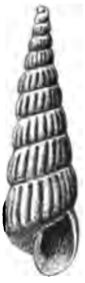

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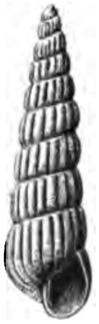
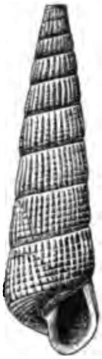


12

TURBONILLA

1. gouldi, p. 66
2. gibbosa, p. 61
3. newcombei, p. 63
4. aurantia, p. 66
5. berryi, p. 69
6. lyalli, p. 68
7. taylori, p. 64
8. valdezi, p. 62
9. alaskana, p. 70
10. ridgwayi, p. 62
11. lowei, p. 64
12. pedroana, p. 67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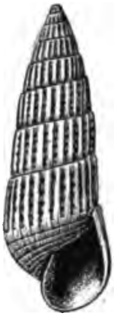
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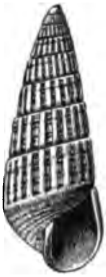
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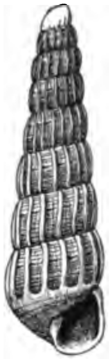
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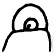
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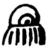
2a

3a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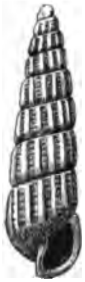
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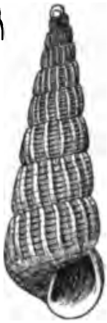
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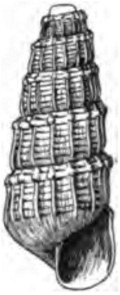
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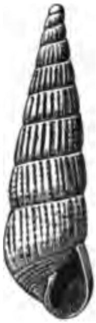
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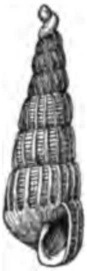
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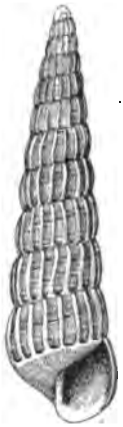
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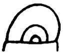
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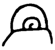
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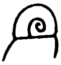
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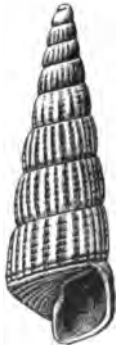
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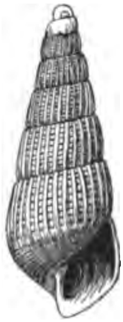
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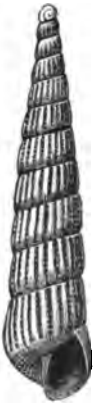
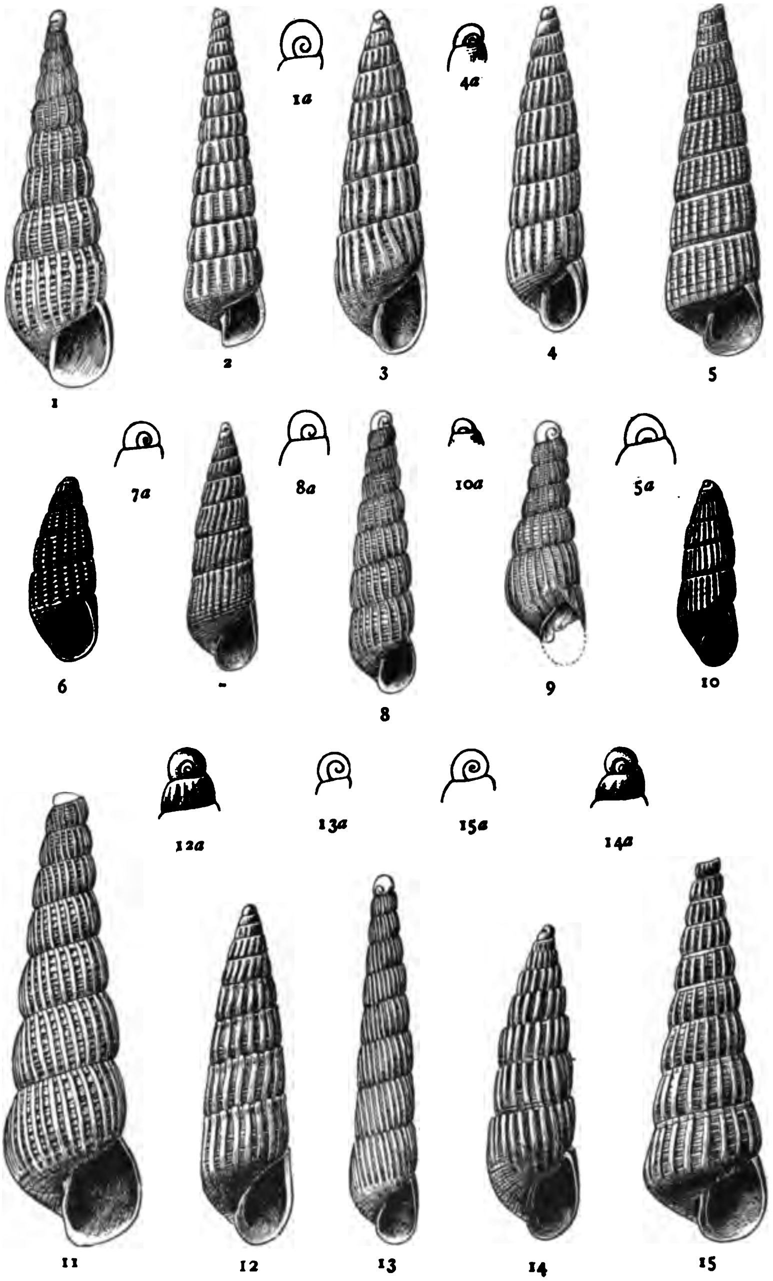

13

TURBONILLA

1. signæ p. 83
2. jewetti, p. 82
3. obesa p 78
4. callia, p. 80.
5. pequensis, p. 79
6. morchi, p. 84
7. annettæ, p. 76
8. striosa, p. 83
9. gracillima, p. 77
10. superba, p. 80
11. vexativa, p 77
12. recta p. 85
13. nuttingi, p. 79



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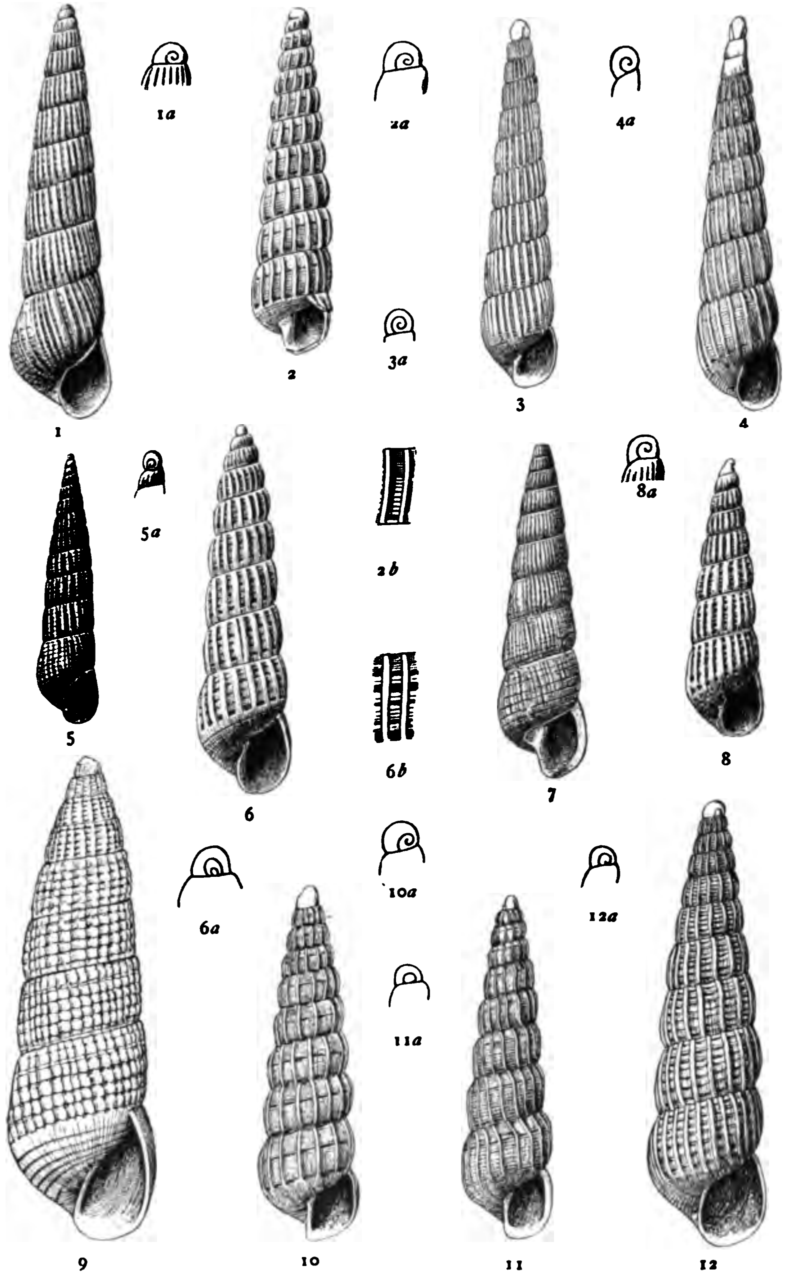
1. nereia, p. 86
2. nuttalli, p. 90
3. tenuicula var., p. 92
4. virgo, p. 93
5. antestriata, p. 87
6. angusta, p. 91
7. tenuicula, p. 92
8. marshalli, p. 94
9. flavescens, p. 89
10. macra, p. 91
11. weldi, p. 86
12. t. crebrifilata, p. 93
13. macbridei, p. 90
14. t. subcuspidata, p. 93
15. antemunda, p. 88.



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1. castanea, p. 101
2. sanctorum, p. 98
3. canfieldi, p. 95
4. shimeki, p. 97
5. auricoma, p. 100
6. halidoma, p. 99
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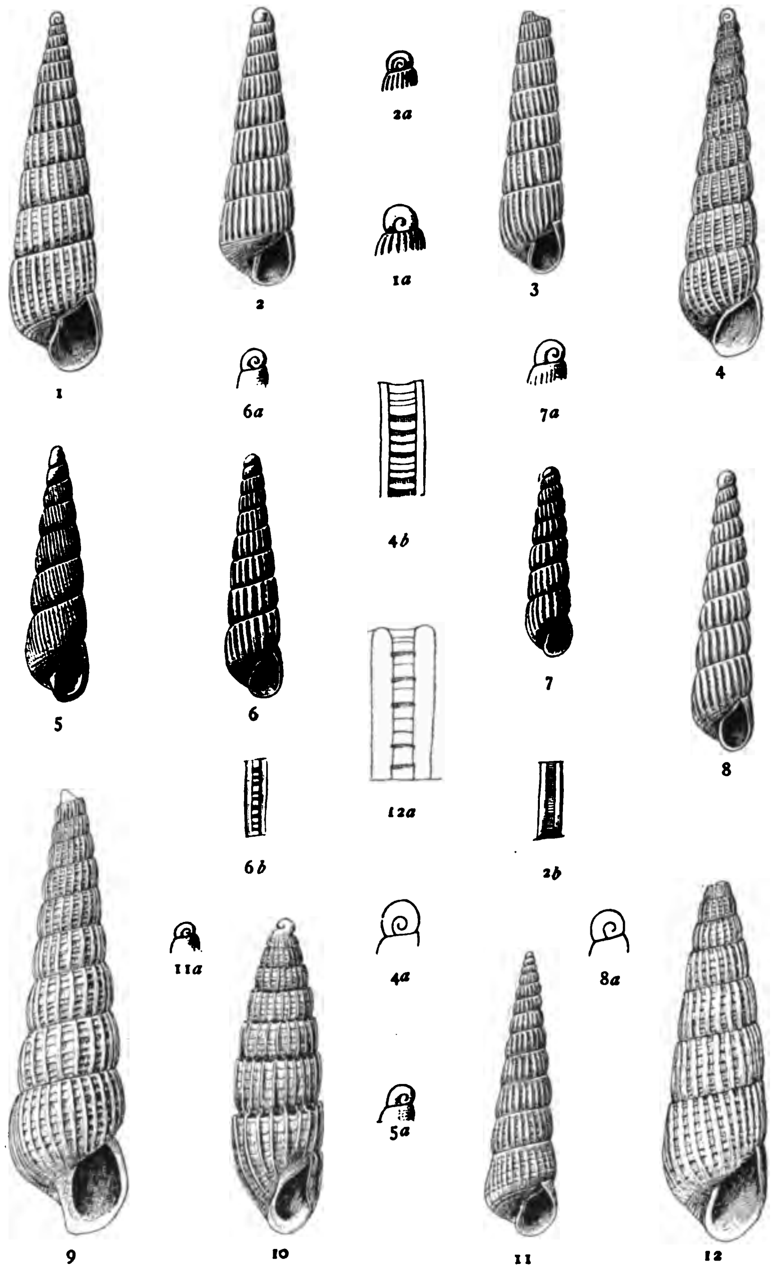
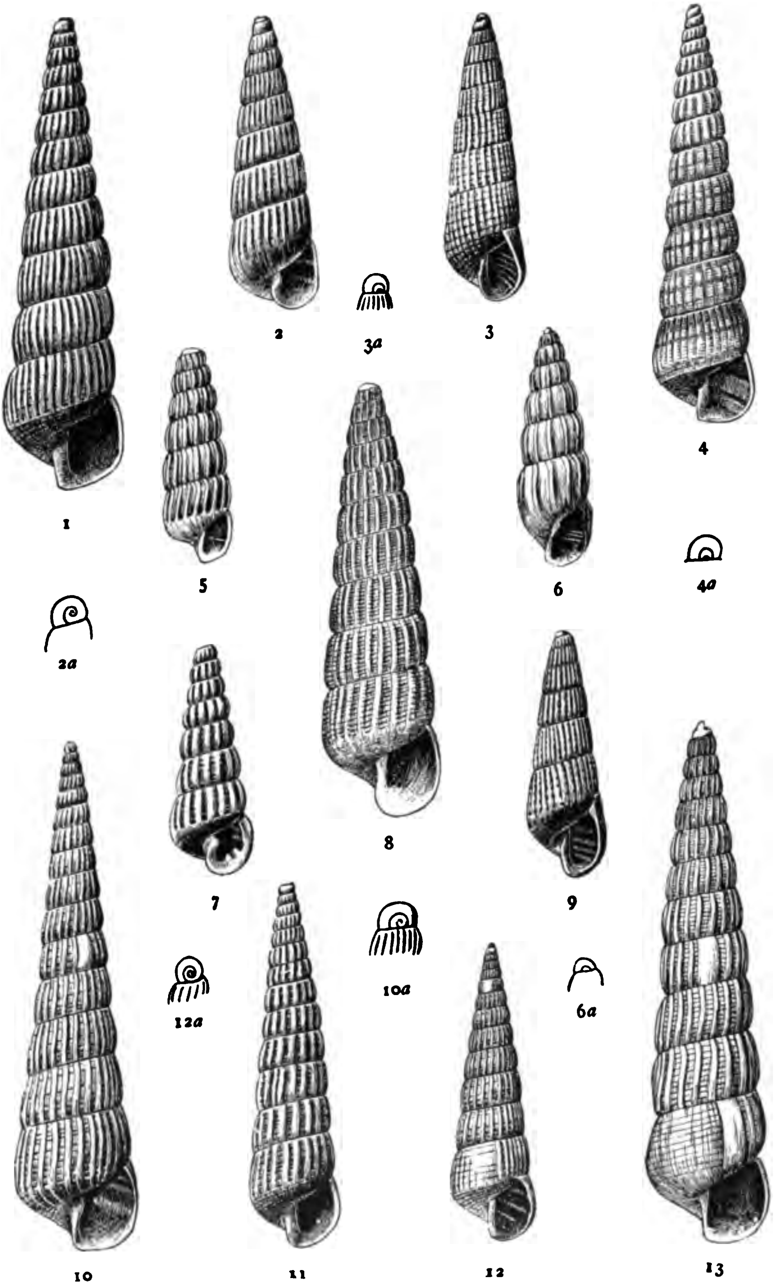
8. almo, p. 95
9. pluto, p. 81
10. dina, p. 96
11. callipeplum, p. 96
12. aragoni, p. 85



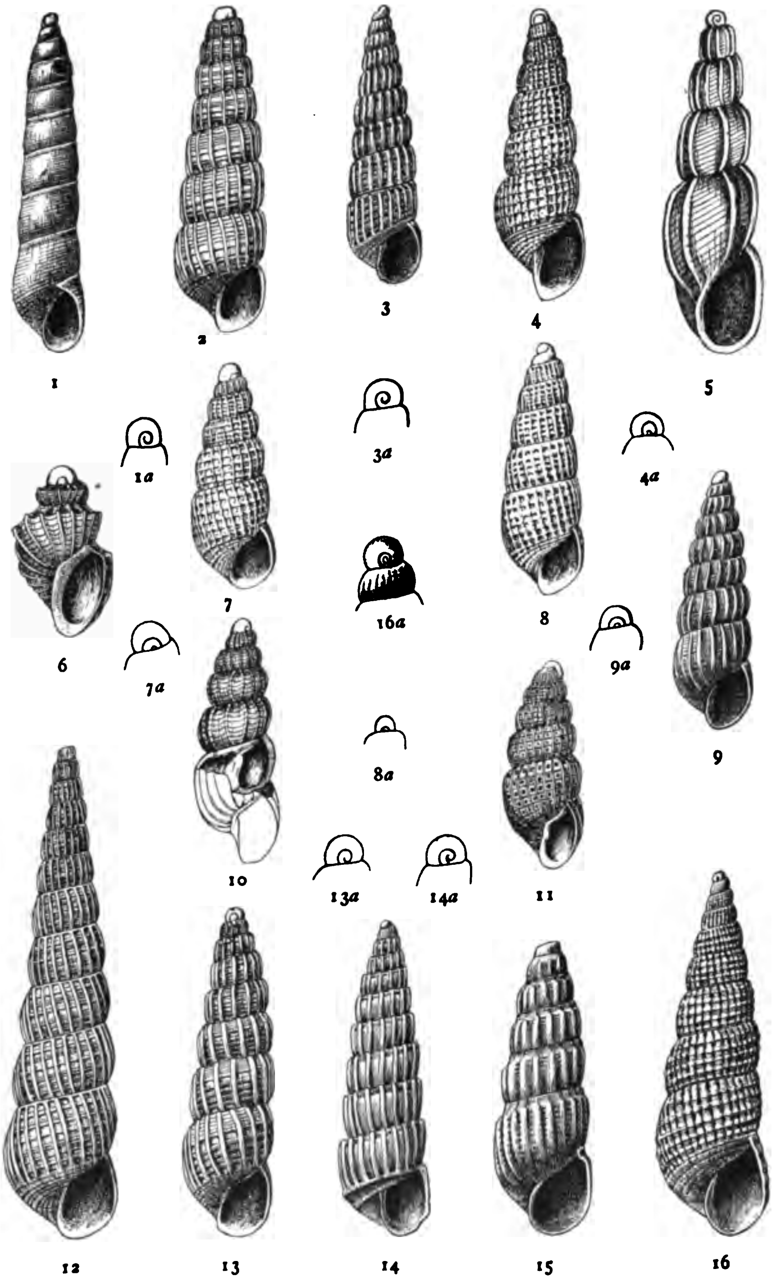
TURBONILLA

1. craticulata, p. 104
2. cinctella, p. 108
3. subula, p. 106
4. larunda, p. 109
5. ceralva, p. 104
6. lara, p. 107
7. lepta, p. 105
8. histias, p. 105
9. wickhami, p. 106
10. indentata, p. 102
11. eucosmobasis, p. 98
12. adusta, p. 108



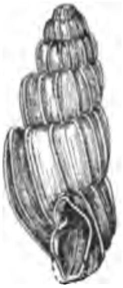
TURBONILLA

1. regina, p. 112
2. ignacia, p. 119
3. pentalopha, p. 117
4. lordi, p. 111
5. phalera, p 120
6. periscelida, p. 119
7. santosana, p. 117
8. eschscholtzi, p. 113
9. heterolopha, p. 118
10. catalinensis, p. 113
11. major, p. 116
12. tridentata, p. 114
13. ambusta, p. 115



TURBONILLA

1. stenogyra, p. 130
2. genilda, p. 125
3. sedillina, p. 121
4. excolpa, p. 123
5. festiva, p. 127
6. cancellata, p. 127
7. andrewsi, p. 124
8. hipolitensis, p. 123
9. swani, p. 129
10. paucilirata, p. 129
11. subangulata, p. 124
12. arata, p. 125
13. eucosmia, p. 128
14. turrita, p. 130
15. monilifera, p. 126
16. laminata, p. 122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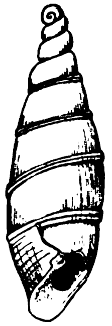
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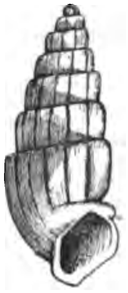
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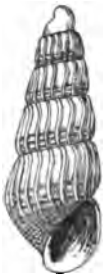
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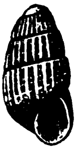
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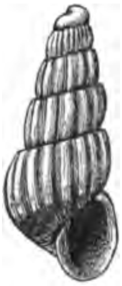
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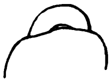
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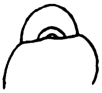
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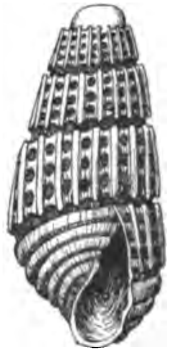
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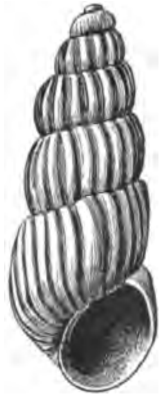
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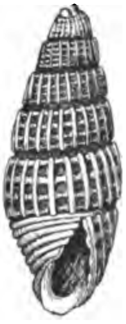
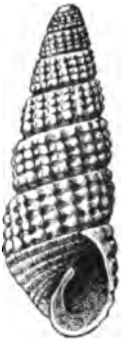

9

ODOSTOMIA

1. scalariformis, p. 135
2. clausiliformis, p. 132
3. tropidita, p. 134
4. convexa, p. 135
5. callimorpha, p. 136
6. richi, p. 133
7. reigeni, p. 138
8. laxa, p. 133
9. telescopium, p. 139



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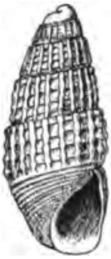

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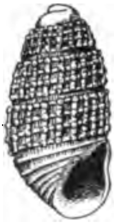

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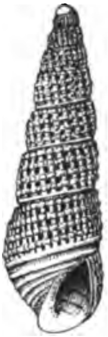

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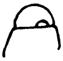

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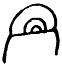

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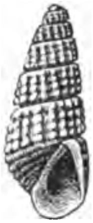

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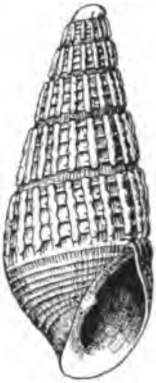

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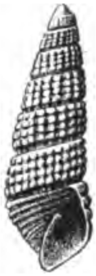

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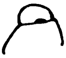

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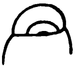

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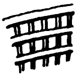

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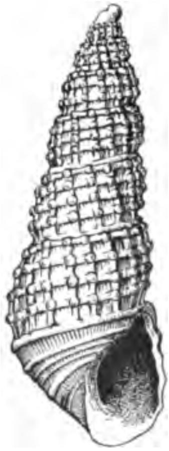

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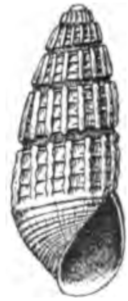

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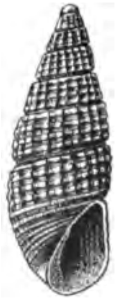

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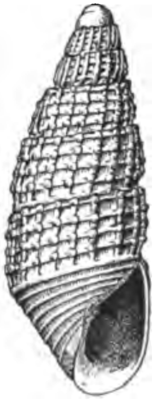
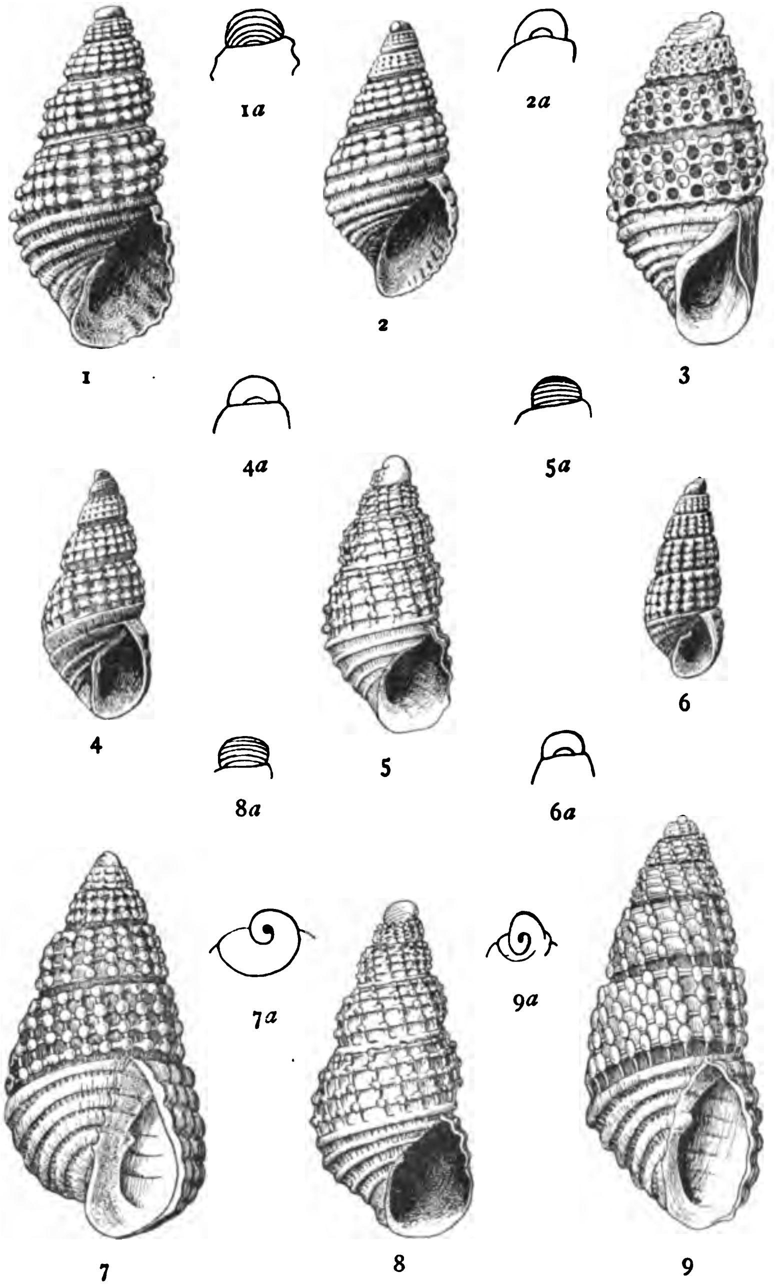


11

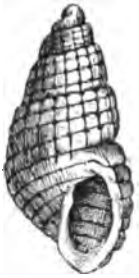
ODOSTOMIA

1. eugena, p. 147
2. torrita, p. 142
3. inconspicua, p. 139
4. paupercula, p. 144
5. effusa. p. 144
6. acrybia, p. 141
7. clathratula, p. 145
8. ritteri, p. 146
9. licina, p. 143
10. communis, p. 141
11. excelsa, p. 140



ODOSTOMIA

1. oldroydi, p. 150
2. cincta, p. 152
3. oonisca, p. 150
4. trachis, p. 148
5. clementina, p. 149
6. rinella, p. 146
7. ovata, p. 152
8. lucca, p. 148
9. nodosa, p. 151



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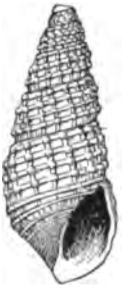

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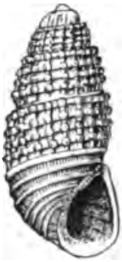

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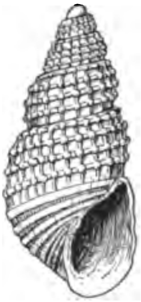

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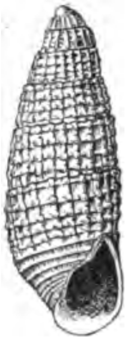

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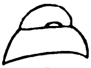

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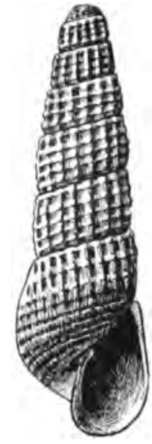

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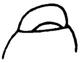

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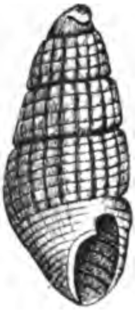

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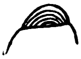

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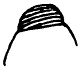

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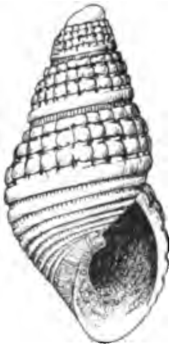

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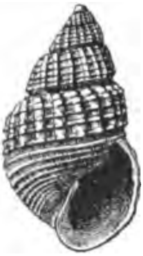

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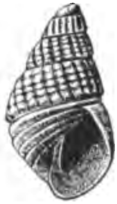

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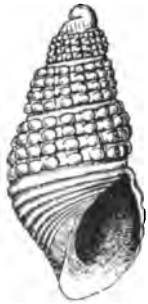
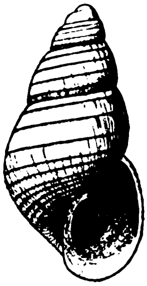


11

ODOSTOMIA

1. pulchra, p. 158
2. astricta, p. 154
3. loomisi, p. 153
4. cooperi, p. 155
5. tyleri, p. 157
6. scammonensis, p. 158
7. proxima, p. 157
8. hipolitensis, p. 155
9. lapazana, p. 156
10. pulcia, p. 160
11. vicola, p. 153



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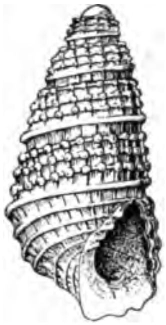

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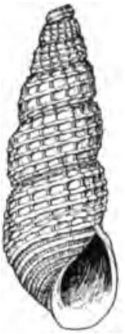

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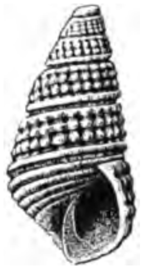

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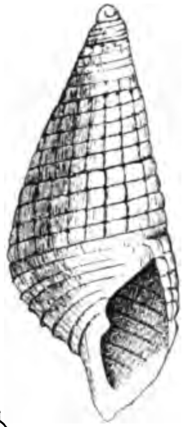

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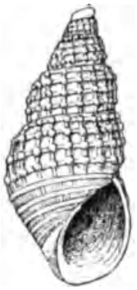

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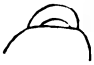

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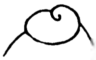

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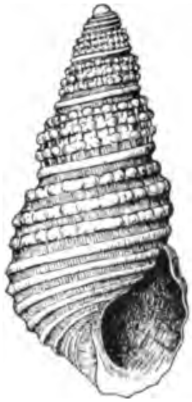

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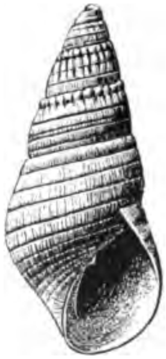

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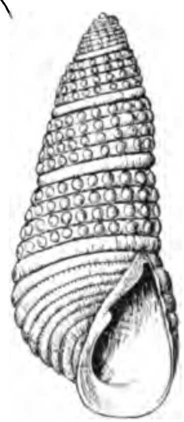
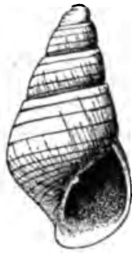


9

ODOSTOMIA

1. deceptrix, p. 169
2. fasciata, p. 165
3. orogonensis, p. 162
4. vincta, p. 165
5. defolinia, p. 161
6. montereyensis, p. 159
7. pulcherrima, p. 164
8. helga, p. 166
9. benthina, p. 163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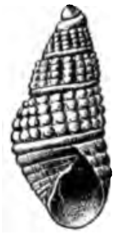
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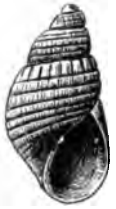
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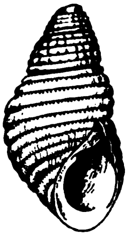
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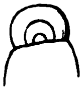
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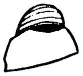
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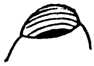
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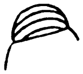
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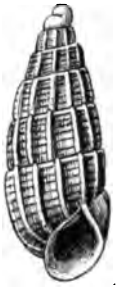
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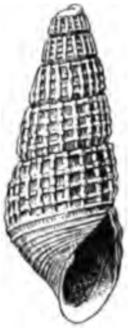
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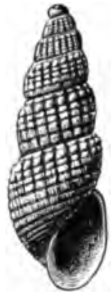
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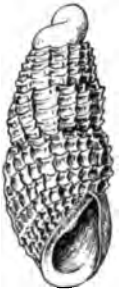
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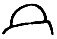
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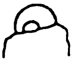
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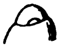
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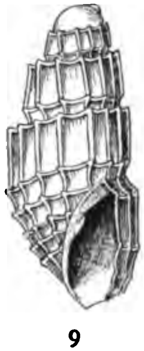
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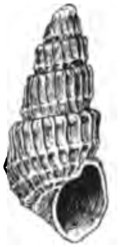
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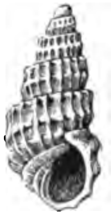
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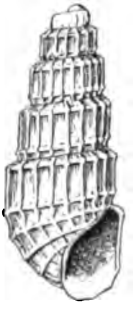
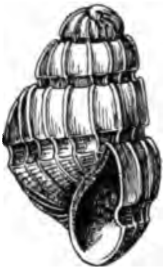

12

ODOSTOMIA

1. sanctorum, p. 167
2. promeces, p. 164
3. sapia, p. 167
4. rotundata, p. 168
5. marginata, p. 169
6. talama, p. 143
7. virginalis, p. 160
8. photis, p. 171
9. quinquecincta, p. 174
10. n. delmontensis, p. 174
11. navisa, p. 173
12. orariana, p. 175



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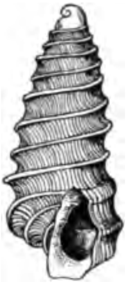

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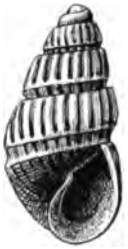

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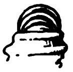

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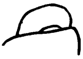

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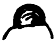

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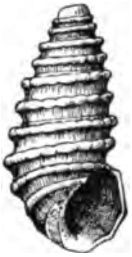

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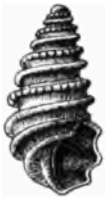

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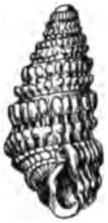

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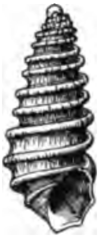

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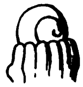

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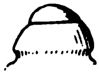

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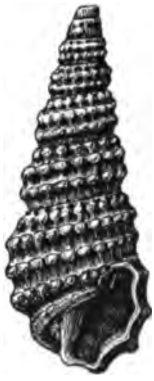

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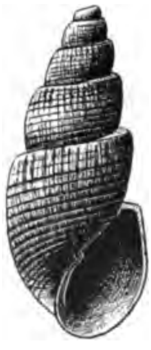

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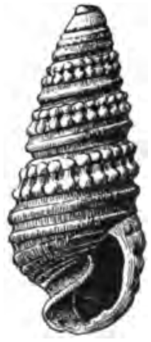
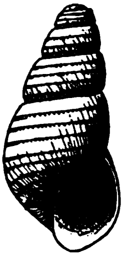


10

ODOSTOMIA

1. lacunata, p. 170
2. exarata, p. 177
3. poppei, p. 170
4. terebellum, p. 177
5. æpynota, p. 178
6. armata, p. 177
7. galapagensis, p. 179
8. pedroana, p. 172
9. turricula, p. 179
10. hemphilli, p. 176



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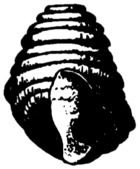

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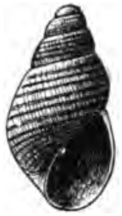

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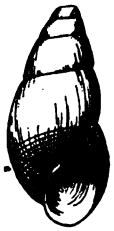

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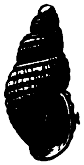

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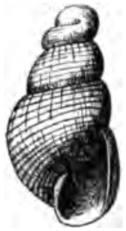

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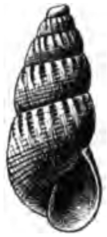

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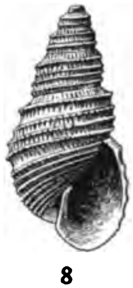

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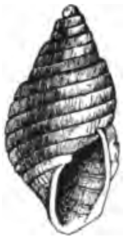

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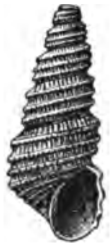
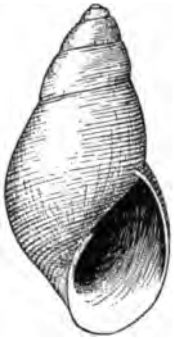


10

ODOSTOMIA

1. farma, p. 188
2. ziziphina, p. 186
3. æquisculpta, p. 191
4. sublirulata, p. 192
5. delicatula, p. 183
6. intermedia, p. 181
7. americana, p. 180
8. amianta, p. 182
9. callipyrga, p. 188
10. eucosmia, p. 183



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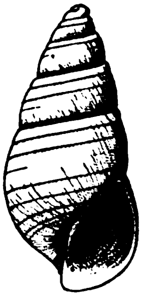

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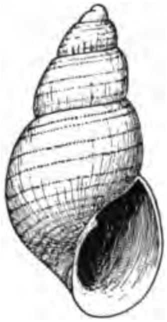

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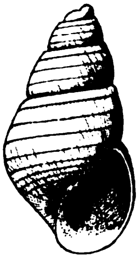

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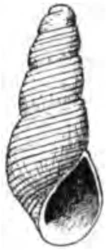

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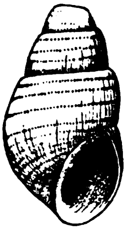

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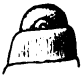

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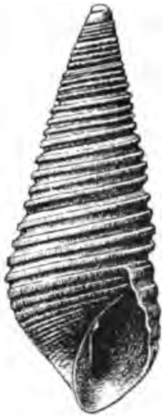

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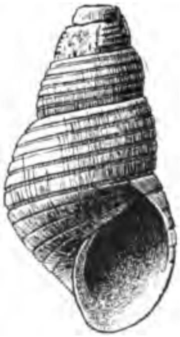

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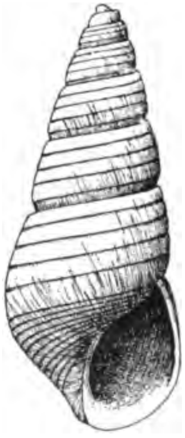
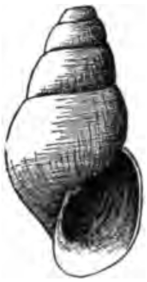


9

ODOSTOMIA

1. exara, p. 186
2. enora, p. 189
3. harfordensis, p. 191
4. amilda, p. 187.
5. pharcida, p. 185
6. chilensis, p. 189
7. grammatospira, p. 185
8. hypocurta, p. 190
9. fetella, p. 189



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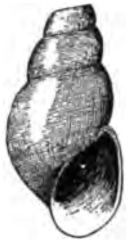

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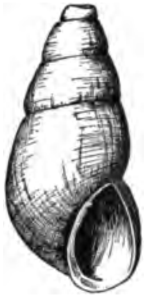

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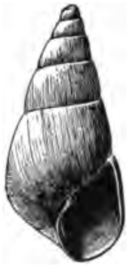

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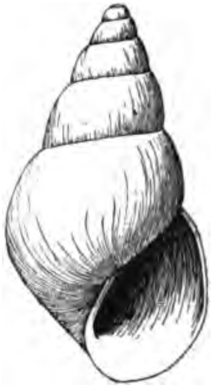

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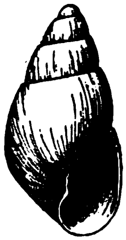

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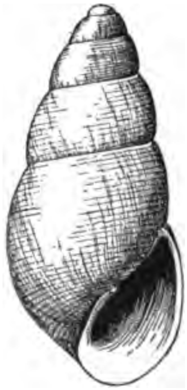

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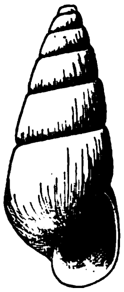

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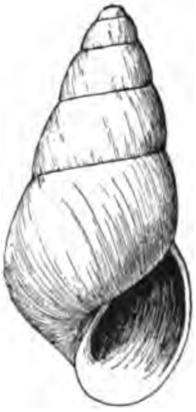
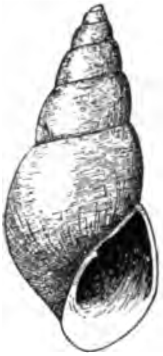


9

ODOSTOMIA

1. esilda, p. 196
2. tillamookensis, p. 195
3. tenuis, p. 197
4. io, p. 199
5. aleutica, p. 196
6. nunivakensis, p. 194
7. killisnooensis, p. 195
8. nemo, p. 198
9. kadiakensis, p. 197



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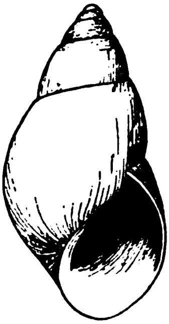

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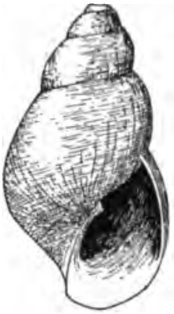

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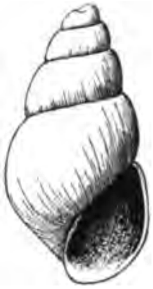

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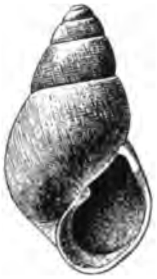

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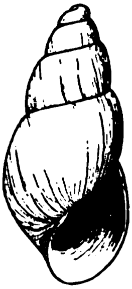

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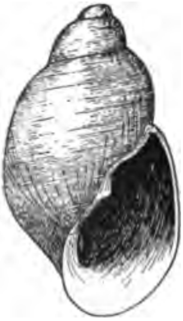

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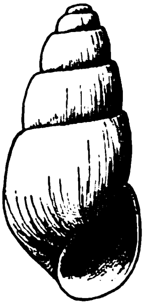

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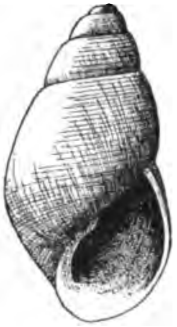
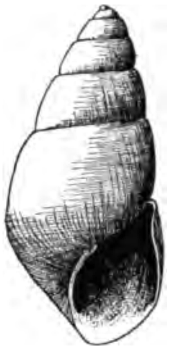


9

ODOSTOMIA

1. columbiana, p. 202
2. tenuisculpta, p. 206
3. jewetti, p. 201
4. pratoma, p. 199
5. phanea, p. 204
6. valdezi, p. 198
7. inflata, p. 201
8. herilda, p. 197
9. phanella, p. 205



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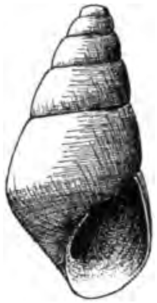

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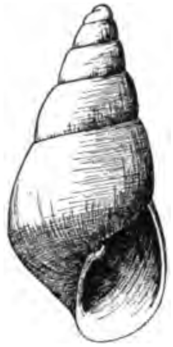

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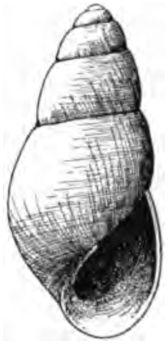

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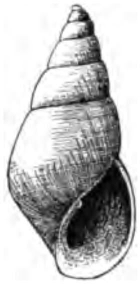

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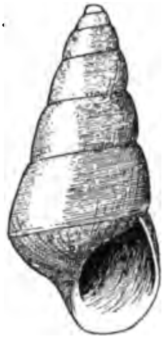

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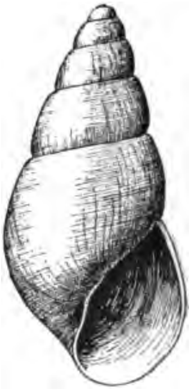

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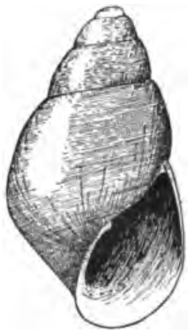

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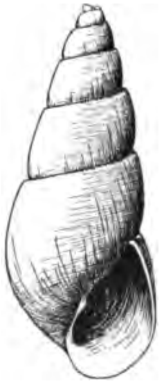
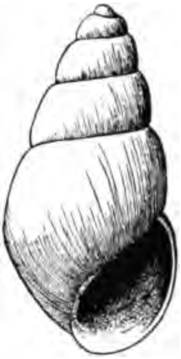


9

ODOSTOMIA

1. socorroensis, p. 208
2. californica, p. 208
3. donilla, p. 208
4. clessini, p. 211
5. stephensi, p. 210
6. angularis, p. 207
7. amchitkana, p. 210
8. tacomaensis, p. 209
9. serilla, p. 209



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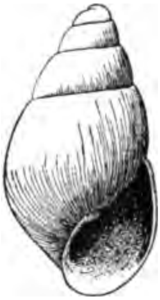

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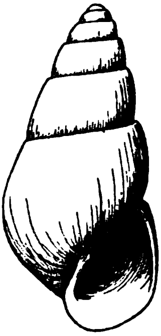

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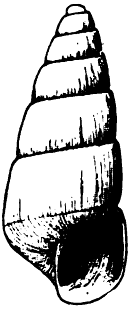

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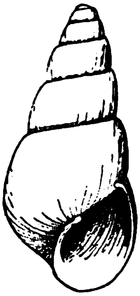

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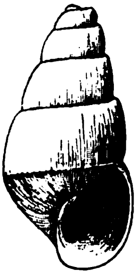

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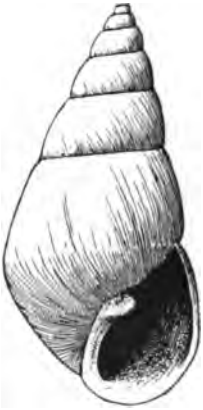

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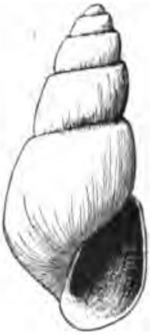

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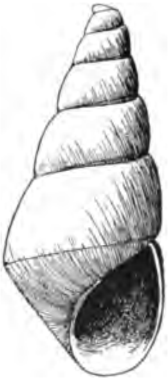
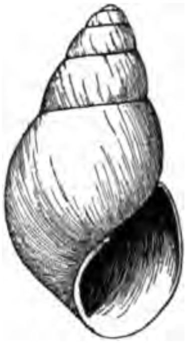


9

ODOSTOMIA

1. movilla, p. 213
2. altina, p. 214
3. baranoffensis, p. 215
4. minutissima, p. 211
5. deliciosa, p. 216
6. notilla, p. 213
7. gravida, p. 212
8. profundicola, p. 214
9. raymondi, p. 212



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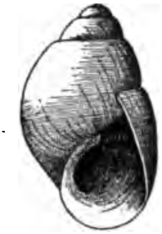

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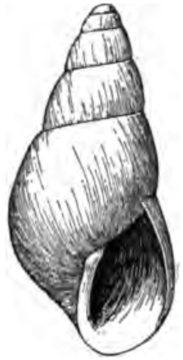

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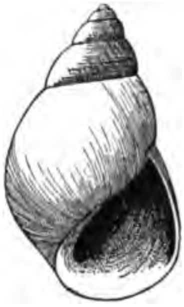

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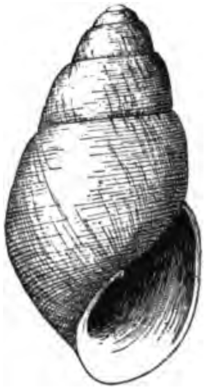

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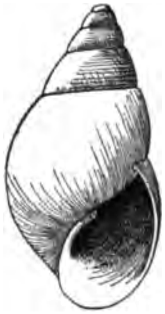

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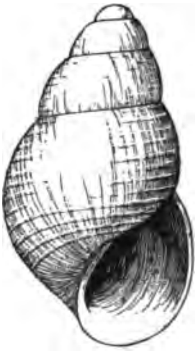

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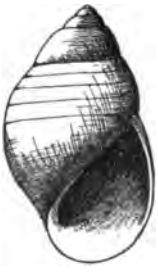

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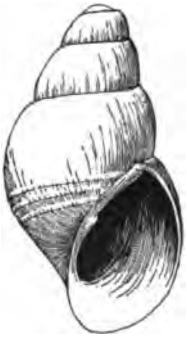

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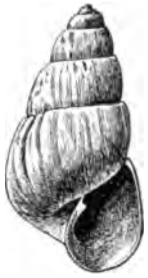

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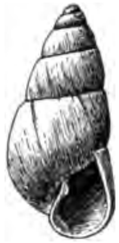

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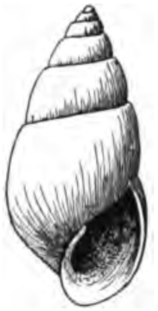

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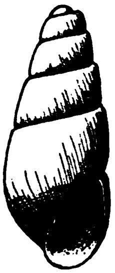

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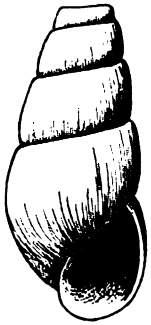

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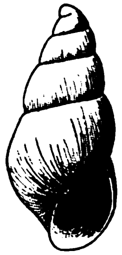

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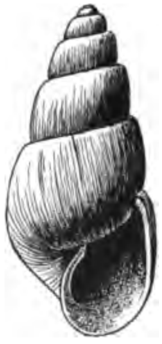

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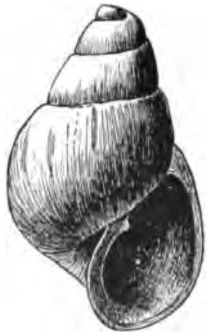

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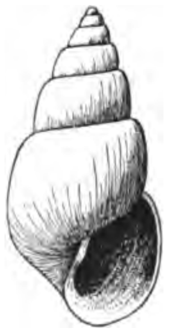

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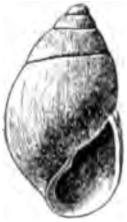
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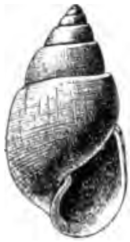
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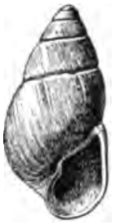
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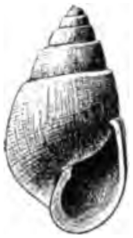
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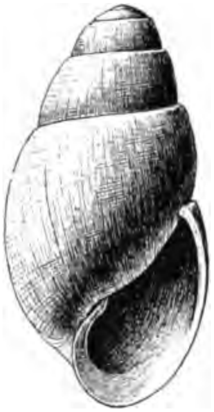
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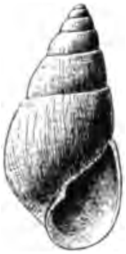
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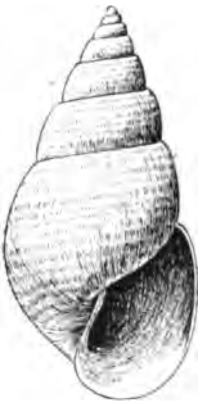
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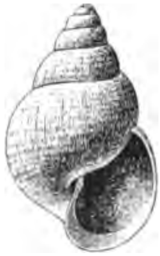
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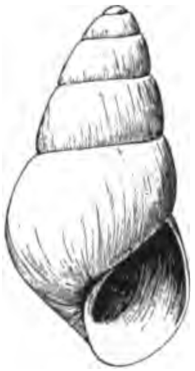
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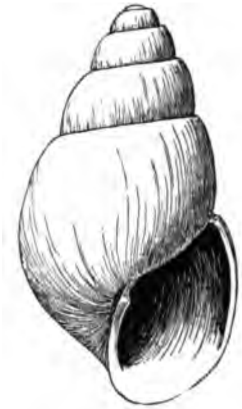

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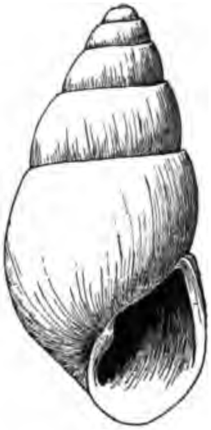

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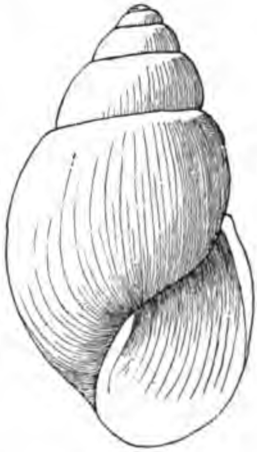

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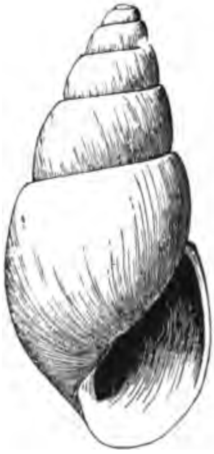

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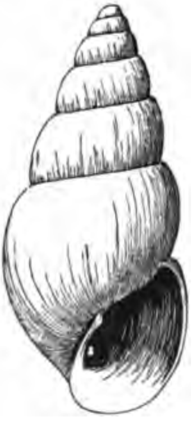

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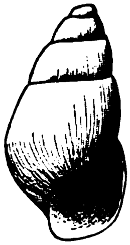

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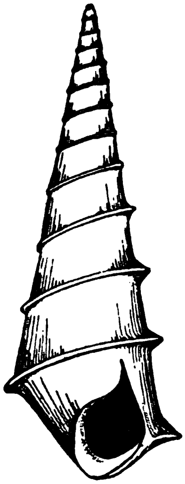

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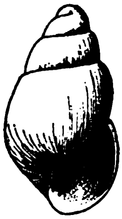

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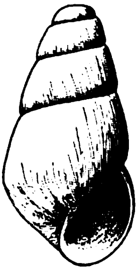

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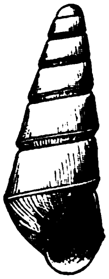

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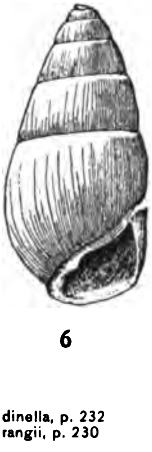

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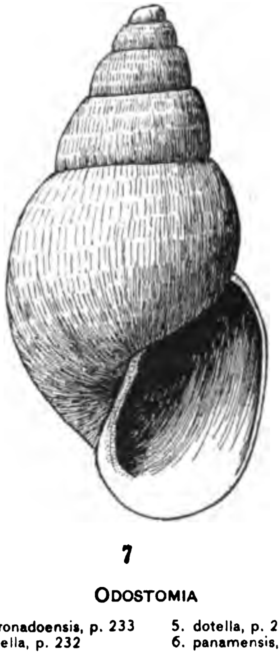

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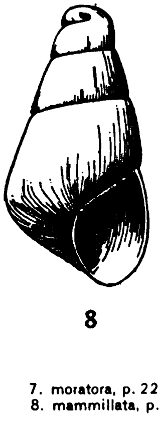

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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
Bulletin 69

THE TÆNIOID CESTODES OF NORTH AMERICAN BIRDS

BY

BRAYTON HOWARD RANSOM
Assistant Custodian, Helminthological Collections, U. S. National Museum

WASHINGTON
GOVERNMENT PRINTING OFFICE
1909

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BULLETIN OF THE UNITED STATES NATIONAL MUSEUM.

Issued December 31, 1909.

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This work forms No. 69 of the Bulletin series.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as bulletins.

The *Proceedings*, the first volume of which was issued in 1878, are intended as a medium of publication of brief original papers based on the collections of the National Museum, and setting forth newly-acquired facts in biology, anthropology, and geology derived therefrom, or containing descriptions of new forms and revisions of limited groups. A volume is issued annually, or oftener, for distribution to libraries and scientific establishments, and in view of the importance of the more prompt dissemination of new facts a limited edition of each paper is printed in pamphlet form in advance.

Richard Rathbun,
Assistant Secretary, Smithsonian Institution,
In Charge of the United States National Museum.

Washington, U. S. A., *December 15, 1909.*

PREFACE.

In 1900, while a graduate student at the University of Nebraska, I undertook, upon the suggestion of Prof. Henry B. Ward, of the department of zoology, an investigation relative to the cestodes of birds. So far as the North American fauna was concerned, this topic represented a field which had scarcely been touched. Although a considerable number of species had been reported from birds occurring in North America, the descriptions of most of these forms were based upon specimens collected in other parts of the world from birds belonging to species whose range included this continent, or which had been introduced here either wild or in a state of domestication.

Owing to interruptions this investigation has never been carried out to the extent originally planned. However, a number of hitherto unknown species, and some already named but imperfectly known species, have been studied and described, and a synopsis prepared of the superfamily Tænioidea to which they belong, together with a list of all the species which have been reported as parasites of birds occurring in North America. This material was presented to the graduate faculty of the University of Nebraska as a thesis for the degree of doctor of philosophy and accepted January 4, 1908. Delay in its final preparation for publication has enabled me to take into consideration a number of recent papers, the most important of which are those of Dr. O. Fuhrmann, the well-known authority on avian cestodes. It has thus been possible to incorporate some valuable data that would otherwise have been omitted.

To Prof. H. B. Ward, of the University of Nebraska, I am indebted for much helpful advice during the progress of my investigations, and to Mr. H. C. Oberholser, of the Biological Survey, U. S. Department of Agriculture, for his kindly assistance in selecting for me the names of hosts as recognized by ornithologists at the present time.

B. H. Ransom.

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THE TÆNIOID CESTODES OF NORTH AMERICAN BIRDS.

By Brayton Howard Ransom,
Assistant Custodian, Helminthological Collections, U. S. National Museum.

INTRODUCTORY REMARKS.

The tænioid cestodes are tapeworms characterized primarily by the presence of four cup-shaped suckers upon the head. They form a natural group, classed by some authorities as a superfamily Tænioidea, by others as an order Cyclophyllidea. At least 8 families may be recognized, and nearly 70 genera. Over 50 of these genera are represented among the species, about 500 in number, parasitic in birds. About 140 species have been reported from North American birds, and these represent nearly 40 genera. It is with these forms that the present paper is concerned. In order to render clear their relationships, it has been considered desirable to include a synopsis of the entire superfamily to which they belong, giving a diagnosis of every known genus in the group and a key to genera. By means of this key a given specimen may readily be placed in its proper genus. Under each genus is given a list of all species known to occur in North American birds, with references to the more important published descriptions which will be of material assistance in arriving at specific determinations, and in this connection the compendium of parasites arranged according to hosts will also be useful.

Preceding the synopsis are given a few notes on the collection and preservation of specimens, and descriptions of a number of species which have been specially studied.

NOTES ON COLLECTION AND PRESERVATION OF SPECIMENS.

The tapeworms of birds are found usually in the small intestine. The collection of specimens is not particularly difficult. The small intestine is slit from end to end with a pair of scissors of suitable size, and by stripping the slit intestine between the thumb and finger or by scraping the inner surface with the back of a scalpel blade the contents are removed into a tall vessel (beaker or glass cylinder) of physiological salt solution. In some cases special care is required if the heads of the worms are to be obtained, and it may be necessary to cut off and place in a shallow dish of salt solution portions of the intestine to which the worms are attached, and by careful manipulation with the back of a scalpel blade cause them to release their hold. In the tall vessel of salt solution the tapeworms and more or less ingesta will sink to the bottom within a few minutes. It is well to break up the masses or clumps of material which sometimes float on the surface of the salt solution in order to dislodge any worms which may be entangled there and thus give them opportunity to sink. When sufficiently settled, the top of the liquid should be poured off until the layer at the bottom containing the tapeworms is reached. The vessel is then filled up again and the liquid stirred a little and allowed to settle as before. This operation is repeated until the fluid is no longer cloudy when agitated. The tapeworms and such ingesta as may be remaining at the bottom are poured out with a sufficient amount of liquid into a shallow flat-bottomed glass dish, for example, a petri dish of suitable size. The worms may now be readily seen by placing the dish over a dark background, and may be picked out by means of a dissecting needle, splinter of wood, etc., or, if very small, by the use of a pipette. It is advisable, in order that very small forms may not be overlooked, that the contents of the dish be carefully examined with a lens. If the worms are small and very numerous, they may be poured with the ingesta and the supernatant liquid into a beaker, as much of the salt solution as possible removed by pouring or by drawing off with a pipette, and the killing solution then added. Otherwise it is better to pick out the worms from the ingesta and put them into a dish of clean salt solution, which may be drawn off and replaced several times in order to free the worms from mucus and adherent foreign particles.

A very satisfactory killing solution is a mixture of equal parts of 70 per cent alcohol and saturated aqueous solution of corrosive sublimate, to which, after mixing, about 1 per cent of glacial acetic acid is added. This mixture may be employed cold, but acts better when heated to about 70° or 80° C. A liberal quantity should be used. The worms may be lifted into the killing solution one by one on a wooden splinter (metal should not be used on account of the action of the corrosive sublimate, which will cause the worms to blacken where touched by the metal), or they may be dumped into the killing reagent together with the least possible quantity of salt solution, or the process may be reversed and the killing reagent poured on the worms after as much of the salt solution as possible is drawn off. When the worms are long and liable to tangle and twist into knots, the first method is preferable. Occasionally the worms, if very active, get into this condition in the salt solution, and require to be disentangled before fixation. This may generally be accomplished with the aid of a couple of dissecting needles.

According to the size of the worms, the killing solution is allowed to act from ten to twenty minutes, rarely longer. It is then poured off or removed with a pipette and replaced with 70 per cent alcohol, to which enough of a solution of iodine in alcohol is added to give it a sherry-wine tint. If after a day or two all the color has disappeared from the alcohol, more iodine solution is added, and this is repeated if necessary. When no further extraction of color is apparent, the alcohol is poured off and fresh 70 per cent alcohol added, in which the specimens may remain until required for study.

When conveniences required in the technic described above are lacking, tapeworms may be preserved by simply opening the intestine of the bird, spreading it out on a piece of board or paper, scraping off the parasites with a knife and putting them directly into 70 per cent alcohol or 5 to 10 per cent solution of formalin. Less favorable specimens are, of course, to be expected from this method than from the other.

The label should show the name of the host (it is important that the species of the bird should be accurately determined, and it is advisable to give the common name as well as the scientific name), the locality, the date, and the collector's name.

Some specimens afford toto mounts favorable for study; in others, on account of the thickness or the contracted condition of the worm, practically nothing can be made out from toto mounts concerning the internal structure, but by pressing a specimen between two glass slides after it has been softened for twelve to twenty-four hours in water and bringing it into strong alcohol again before the pressure is removed, it can generally be sufficiently flattened so that the internal structure becomes more apparent. Before this flattening is done, however, the specimens should be stained, the most generally useful stain being alcoholic acid carmine. The specimens may be stained overnight in dilute stain and then decolorized by soaking in 70 per cent alcohol, to which two or three drops of hydrochloric acid to the 100 c. c. have been added. The stage at which to stop decolorization can only be determined by experience. After staining and flattening, the specimens are dehydrated, cleared in xylene or cedar oil, and mounted in balsam. Small worms may be mounted entire, larger ones in pieces. If the head is armed with hooks and their shape and size can not be accurately determined in a toto mount, and if a sufficient number of specimens are available, preparations to show these structures may be made by tearing the heads into small pieces with fine pointed needles and mounting in glycerin, glycerin jelly, or balsam.

In addition to toto mounts serial sections are indispensable in working out the details of internal structure. These should be made with portions from various regions of the strobila chosen to show the male and female organs in different stages of development. Transverse and frontal sections are the most useful; occasionally sagittal sections are valuable. Except for fine histological details, thick sections are more satisfactory than thin ones.

DESCRIPTION OF SPECIES.

Genus DAVAINEA Blanchard and Railliet, 1891.

(For generic diagnosis see p. 67.)

DAVAINEA RHYNCHOTA, new species.

Figs. 1–4.

This species is represented by specimens in the collection of the U. S. National Museum, and of H. B. Ward, collected in Nebraska, Iowa, and Maryland, from *Colaptes auratus* and *Melanerpes erythrocephalus.*

The type-specimens (from the collection of H. B. Ward, deposited in the U. S. National Museum Helminthological Collection, No. 7235) were collected in Iowa from *Colaptes auratus.*

External anatomy.

The length of this form is 50 to 60 mm., the maximum width about 1 mm.

The head (fig. 1) measures 360 to 380μ long and 320 to 380μ broad. Its anterior portion forms a large protuberance, cylindrical or truncate conical in shape, measuring 160μ in length by 150 to 250μ in breadth. The surface of this protuberance, as in *Davainea frontina* (Dujardin), is thickly covered with minute spines arranged in diagonal rows. The rostellum proper is a muscular bulb, broad (120 to 160μ) and flat, embedded in the anterior end of the spine-covered protuberance. It is armed with a crown of alternating longer and shorter hooks (figs. 2*a* and *b*), 18 and 14μ in length, respectively, and about 400 in number. Instead of being circular the crown of hooks forms a rosette with 8 limbs.

The suckers are round, 150 to 160μ in diameter, with their borders armed with numerous hooklets (fig. 2*c*) of varying size up to 10μ, arranged in diagonal rows, 16 to 18 hooklets in each row.

The neck is somewhat narrower than the head, measuring 160 to 250μ in breadth, and varying in length according to the state of contraction (observed maximum 400μ). The first segments are equal in width to the neck and are very short, gradually increasing in both dimensions toward the posterior end of the strobila, where they measure 0.5 mm. in length and 1 mm. in width. The number of segments in a strobila 50 mm. long was about 175. The posterior 8 or 10 segments in this strobila contained fully formed eggs. In shape the segments are trapezoidal, broader than long, and the posterior border of each segment overlaps more or less the anterior portion of the next following segment.

The genital pores are unilateral on the left-hand margin of the strobila, located slightly in front of the middle of each segment.

Internal anatomy.

Nervous system.—The lateral longitudinal nerves are well developed, situated toward the lateral borders of the segment just within the inner layer of longitudinal muscles.

Muscle system.—The longitudinal muscles are arranged in two layers; a thicker outer layer of several irregular rows of very numerous small bundles and a thinner inner layer of larger bundles in a single row, about 40 in number, 20 in the dorsal and 20 in the ventral half of the segment. The dorso-ventral and transverse muscle systems are very weakly developed.

Excretory system.—The dorsal (fig. 3, *d. ex.*) and the ventral excretory canal are situated in about the same vertical longitudinal plane a short distance from the lateral nerve on its inner side.. The dorsal canal is, as usual, the smaller and its course more wavy.

In a segment in which the ventral canals measured 60μ in diameter the dorsal canals measured 15μ. The ventral canals are connected by a transverse canal in the posterior portion of each segment; the dorsal canals (fig. 3) are also connected in the same region in most of the segments by a slender transverse canal.

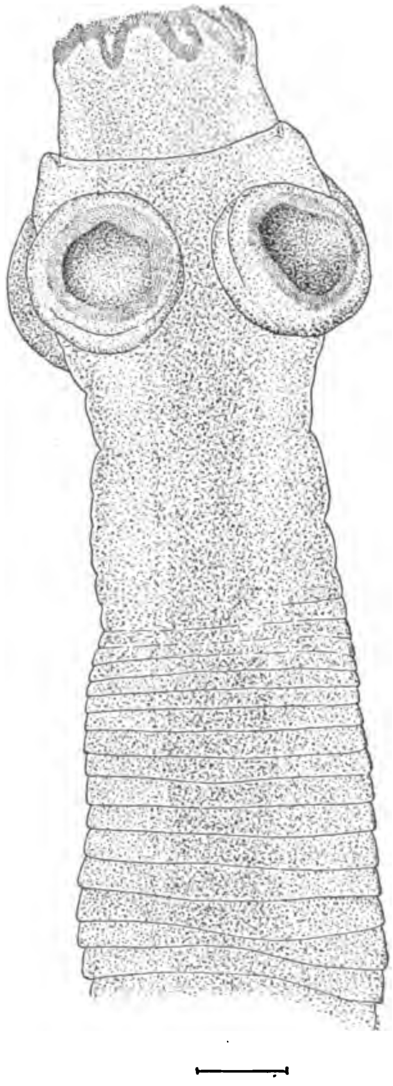

FIG. 1.—DAVAINEA RHYNCHOTA: HEAD AND ANTERIOR PORTION OF STROBILA.

With the exception of the cirrus pouch and the distal portion of the vagina, the reproductive organs are all contained in the medullary portion of the segment, as the portion within the inner longitudinal muscle layer may be termed. The vas deferens and vagina pass between the dorsal and ventral excretory canals and dorsal of the lateral longitudinal nerve.

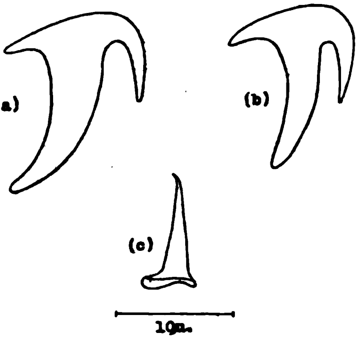

FIG. 2.—DAVAINEA RHYNCHOTA: HOOKS. (*a*) LARGE HOOK FROM ROSTELLUM. (*b*) SMALL HOOK FROM ROSTELLUM. (*c*) HOOK FROM SUCKER.

Male reproductive organs.—The testicles (fig. 3, *t.*) are of the usual oval shape, elongated dorso-ventrally, measuring 60 to 120μ in diameter, in number about 24. They are located in the lateral and posterior portions of the segment, inside of the inner layer of longitudinal muscles, extending forward to the anterior border of the segment on the dextral side. On the sinistral side of the segment the testicles do not extend so far forward, the anterior third of the segment on this side being occupied by the vas deferens and seminal receptacle.

In segments in which the female glands are at the height of their development the testicles in the middle third of the segment are crowded toward the sides and are then disposed in two groups, one in each lateral third of the medullary portion of the segment. In a segment containing 22 testicles, 9 were located on the left-hand (pore) side of the segment and 13 on the right-hand side. The vasa efferentia unite near the middle of the segment, toward the dorsal

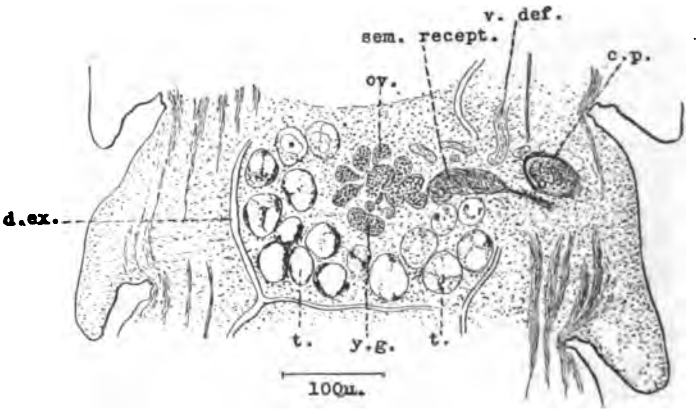

FIG. 3.—DAVAINEA RHYNCHOTA: SEXUALLY MATURE SEGMENT, HORIZONTAL SECTION. *c. p.*, CIRRUS POUCH. *d. ex.*, DORSAL EXCRETORY VESSEL. *ov.*, OVARY. *sem. recept.*, SEMINAL RECEPTACLE. *t.*, TESTICLES. *v. def.*, VAS DEFERENS. *y. g.*, YOLK GLAND.

side of the medullary portion, to form the vas deferens, which extends forward nearly to the anterior border of the segment, and then laterally in a very tortuous course toward the genital pore. The mass of coils formed by the vas deferens occupies most of the anterior third of the medullary portion of the segment on the left-hand side of the median line. The middle portion of the vas deferens is commonly dilated in older segments, forming a capacious seminal reservoir measuring 40 to 60μ in diameter; the remainder of the vas deferens measures about 10μ in diameter.

The cirrus pouch (figs. 3, 4, *c. p.*) measures 115 to 135μ in length and has the pyriform shape common in the genus *Davainea*. The outer muscular layer is very thin, 2 to 3μ, the fibers running mostly lengthwise in the basal portion and transversely in the distal portion of the pouch. The vas deferens after entering the cirrus pouch is supplied with a muscular wall, and its terminal portion is modified to form the cirrus, which in the retracted condition measures 50 to 60μ in length and 2 to 4μ in diameter, without apparent spines.

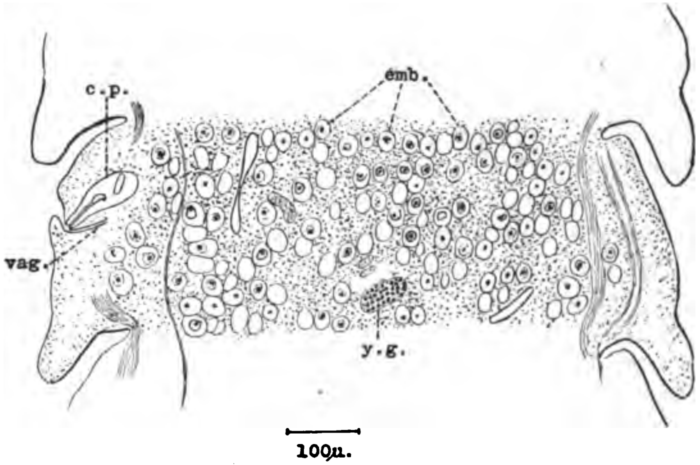

FIG. 4.—DAVAINEA RHYNCHOTA: GRAVID SEGMENT, HORIZONTAL SECTION. *c. p.*, CIRRUS POUCH. *emb.*, EGGS. *vag.*, VAGINA. *y. g.*, YOLK GLAND.

Female reproductive organs.—The vagina (fig. 4, *vag.*) opens into the genital sinus immediately behind the male opening, and extends inwards along the posterior side of the cirrus pouch. The distal portion of the vagina has a thick muscular wall and measures from 200 to 235μ in length. Before crossing the excretory canals the vagina becomes very thin-walled, and in older segments the thin-walled portion is dilated to form an elongated seminal receptacle (fig. 3, *sem. recept.*). Near the center of the segment the vagina joins the oviduct.

The ovary (fig. 3, *ov.*) is situated in the middle of the segment, and measures about 250 to 320μ in width when fully developed. It is a compact lobulated organ deeply hollowed out behind. In this space is situated the yolk gland (fig. 3, *y. g.*) ventrally, and the shell gland dorsally. The yolk gland measures from 75 to 100μ in diameter and the shell gland from 30 to 50μ.

As in other members of the genus *Davainea*, a definite functional uterus is not developed. The eggs (fig. 4, *emb.*) in gravid segments are scattered throughout the medullary portion, isolated in the parenchyma and not grouped together in capsules. They are surrounded by three membranes, a thin inner one close to the oncosphere, which measures 20 to 25μ in diameter, a thicker middle one 27 to 33μ in diameter, and a thin outer membrane 35 to 50μ in diameter. The last is apparently deposited by small cells 4 to 6μ in diameter, with deep staining nuclei about 2μ in diameter, which largely fill up the spaces between the eggs.

Remarks.

Davainea compacta Clerc (1906, p. 725, fig. 22) from *Oriolus galbula* is very similar to *D. rhynchota.* As described by Clerc it is 150 mm. in length by 1.3 mm. in breadth. The scolex is 330μ in diameter. The rostellum is armed with about 400 hooks arranged in two rows. The larger hooks measure 15μ in length. The hooks on the suckers measure 10μ in length. The segments are always broader than long. The genital pores are unilateral and the genital canals pass between the excretory vessels. The testicles are about 25 in number and the cirrus pouch measures 150μ in length. The ovary occupies about one-third the width of the segment. The eggs are very small, the embryo measuring but 14μ in diameter, and they are contained singly in egg capsules.

Davainea compacta and *D. rhynchota* correspond very well in the size of the head, number, and size of hooks on the rostellum, their arrangement in a double crown, size of the hooks on the suckers, unilaterality of the genital pores, shape of the segments, number of testicles, size of the ovary, and the arrangement of the eggs singly in egg capsules. *Davainea compacta*, however, is a much longer species than *D. rhynchota* (not an important difference), the cirrus pouch is somewhat larger, and the eggs are much smaller, the embryo of the former being but 14μ in diameter, of the latter about 25μ. The two apparently differ in regard to the rostellum. The presence of spines over the surface of the very prominent rostellum, and the rosette arrangement of the hooks are marked features of *Davainea rhynchota*, which would hardly have been overlooked by Clerc if they were present in *Davainea compacta.* The differences between the two forms seem fully sufficient to justify the recognition of the two species.

Of the tapeworms which have been reported from woodpeckers, *Davainea cruciata* (Rudolphi) and *D. longispina* Fuhrmann, 1908, are the only other species of this genus besides *Davainea rhynchota*, in which the eggs are not grouped in egg capsules. *Davainea cruciata*, as described by Fuhrmann (1909, p. 111) from the type-specimens, possesses only about 200 hooks on the rostellum, and the cirrus pouch measures only about 70μ in length. This species is therefore clearly different from *D. rhynchota*. That *D. longispina* as described by Fuhrmann (1909, p. 112) is a different species from *D. rhynchota* is evident from the facts that the rostellum measures but 64μ in diameter and that the genital pore is located in the posterior half of the segment.

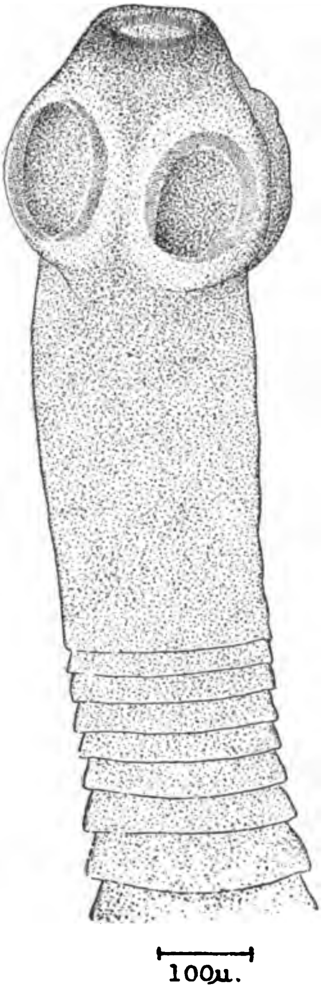

FIG. 5.—DAVAINEA COMITATA: HEAD AND ANTERIOR PORTION OF STROBILA.

DAVAINEA COMITATA, new species.

Figures 5–8.

This form occurs in *Colaptes auratus* and *Melanerpes erythrocephalus*, commonly in company with the preceding species. It has been collected in Iowa, Nebraska, and Maryland. The type-specimen (from the collection of H. B. Ward, deposited in the U. S. National Museum Helminthological Collection, No. 7234) was collected in Iowa from *Colaptes auratus*.

External anatomy.

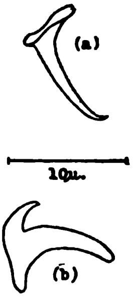

FIG. 6.—DAVAINEA COMITATA: HOOKS. (*a*) FROM SUCKER. (*b*) FROM ROSTELLUM.

Davainea comitata measures 45 to 55 mm. in length, with a maximum breadth of 1.16 mm.

The head (fig. 5) is 250 to 320μ long and 250 to 290μ broad, covered thickly with minute spines in its anterior portion over a zone about 75μ in width bordering the rostellum. This spine-covered zone corresponds to the prominent protuberance of the head in *Davainea rhynchota*. The rostellum is about 90μ in diameter, armed with a crown of about 80 hooks (fig. 6*b*) 11 to 13μ long arranged in a single row.

The suckers are oval, 115 to 135µ wide by 160µ long, armed with numerous hooklets (fig. 6*a*) 10µ and less in length, arranged in diagonal rows on the border of the suckers, 16 to 18 in each row.

The neck is of variable length up to 400µ, and measures in width from 200 to 300µ.

The segments are similar in shape to those of *Davainea rhynchota* and increase gradually in size toward the posterior end of the strobila. In a strobila 45 mm. long the number of segments was approximately 175, of which the last 17 contained egg capsules. A segment (No. 130) in the middle of the strobila measured 320µ in length by 880µ in width, and a segment at the end of the strobila measured 650µ in length by 1.6 mm. in breadth. In some cases the gravid segments are equal in length and breadth.

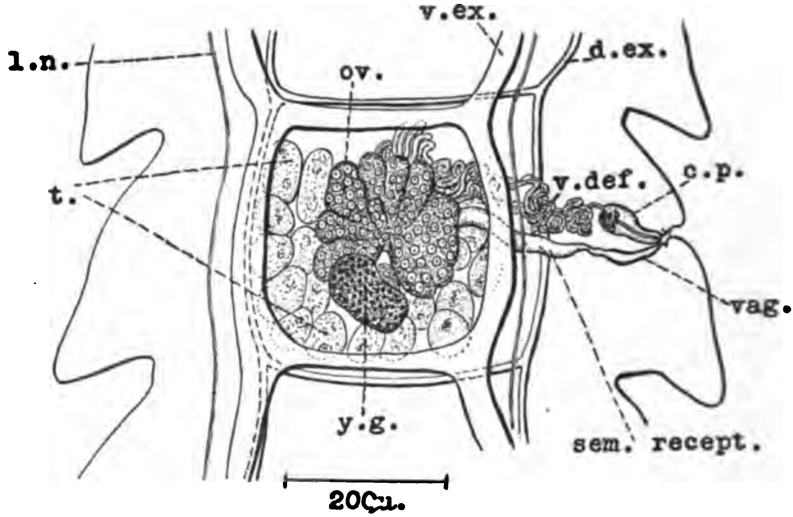

Fig. 7.—Davainea comitata: Sexually mature segment, reconstruction from sections, ventral view. *c. p.*, Cirrus pouch. *d. ex.*, Dorsal excretory vessel. *l. n.*, Nerve cord. *ov.*, Ovary. *sem. recept.*, Seminal receptacle. *t.*, Testicles. *vag.*, Vagina. *v. def.*, Vas deferens. *v. ex.*, Ventral excretory vessel. *y. g.*, Yolk gland.

The genital pores are unilateral on the left-hand margin of the strobila, situated in about the middle of each segment.

Internal anatomy.

The nervous system, musculature, and excretory canals are arranged as in *Davainea rhynchota*, and the relative location of the reproductive organs is the same.

The vas deferens and vagina pass between the excretory canals and dorsal of the nerve cord, as in the other species.

Male reproductive organs.—The testicles (fig. 7, *t.*) number from 30 to 35, arranged in a mass occupying the lateral and posterior portions of the segment within the inner field. As in *Davainea rhynchota*, on the right-hand side this mass extends nearly to the anterior border of the segment; on the left-hand (pore) side it is limited to the posterior two-thirds. The vas deferens (fig. 7, *v. def.*) forms a mass of coils in the anterior third of the segment extending from the median line to the base of the cirrus pouch. The cirrus pouch (figs. 7, 8, *c. p.*) is pyriform in shape, with thin outer muscular wall, as in *Davainea rhynchota.* It is, however, somewhat smaller in the present species, measuring 90 to 100μ in length by 45 to 50μ in diameter in its widest portion. The arrangement in the pouch of the vas deferens and cirrus is similar to that in the other species. The cirrus is without apparent spines, and measures in the retracted condition about 50μ in length by 2 to 4μ in diameter.

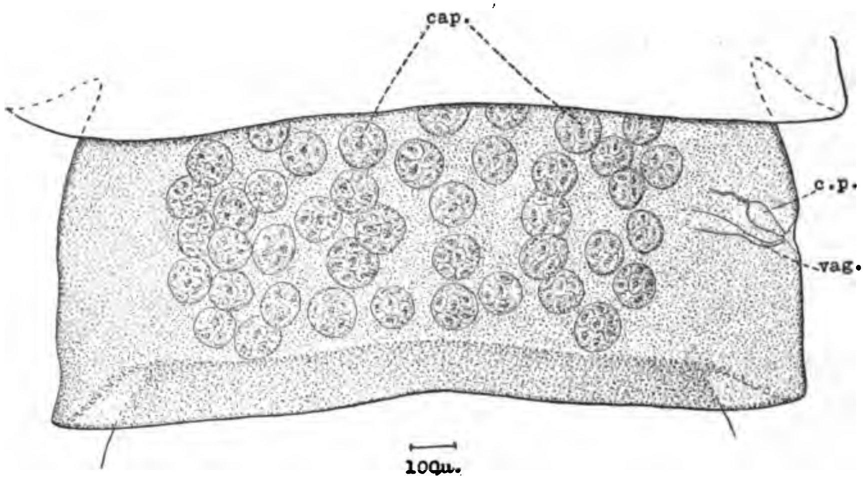

FIG. 8.—DAVAINEA COMITATA: GRAVID SEGMENT, VENTRAL VIEW. *cap.*, EGG CAPSULES. *c. p.*, CIRRUS POUCH. *vag.*, VAGINA.

Female organs.—The vaginal opening is immediately posterior of the male opening. The vagina and seminal receptacle are in this form similar to those of *Davainea rhynchota*, with the exception that the vagina for a distance of 25μ from the genital pore is constricted, and this constricted portion is surrounded by a bulbous sphincter.

The ovary (fig. 7, *ov.*), located as in *Davainea rhynchota*, is similar in shape, lobulation, etc., and measures about 200μ in width at its maximum of development.

Posterior and ventral of the ovary is the yolk gland (fig. 7, *y. g.*) 100 to 130μ in diameter, and dorsal and anterior of the latter is the small shell gland, 50μ in diameter.

In the gravid segment the eggs are grouped 6 to 12 together in egg capsules (fig. 8, *cap.*), measuring 80 to 90μ in diameter. From 40 to 50 capsules are visible from a surface view of the segment. They are confined to the medullary portion of the segment inside the inner layer of longitudinal muscles. The eggs are supplied with two thin membranes, an inner one close to the oncosphere, which measures 18 to 20μ in diameter, and an outer one 30 to 35μ in diameter.

Remarks.

In addition to *D. comitata*, two species of *Davainea*, in which the eggs are grouped in egg capsules, have been reported from woodpeckers—namely *Davainea frontina* (Dujardin) and *D. lutzi* Parona. It is possible that in *D. cruciata* (Rudolphi) also there is a grouping of the eggs in egg capsules, but Fuhrmann (1909, p. 111) says that the eggs, probably, are isolated in the parenchyma, as in *D. longispina* Fuhrmann. *D. comitata* is certainly, however, specifically different from *D. cruciata*, since it possesses only about 80 hooks on the rostellum, whereas the latter has about 200. *Davainea frontina* has about 280 hooks and is thus distinct from *D. comitata*. The size of the hooks in *D. lutzi*—namely, 18 to 19μ in length—distinguishes this species from *D. comitata*, whose hooks are only 11 to 13μ in length. The two species are also different, in that *D. lutzi* has but 12 to 16 egg capsules in each segment (Fuhrmann, 1909, p. 112), while *D. comitata* has 40 to 50.

Genus LIGA Weinland, 1857.

For generic diagnosis see p. 80.)

The genus *Liga*, proposed by Weinland (1857b, p. 62), has up to the present time received practically no recognition by other authors, and in few instances has it even been mentioned. Stiles (1906a, p. 62) lists *Liga* as a possible synonym of *Davainea* and also refers to it in an earlier paper (1903hh); it has also been noted by Fuhrmann (1907a, p. 292; 1908a, p. 60), but other writers have passed it by without comment.

Weinland's original description of *Liga* and its type species *Liga punctata* is as follows:

> OBSERVATIONS ON A NEW GENUS OF TÆNIOIDS.
>
> In the middle of April, 1856, I found a single living specimen of a new kind of tapeworm in the small intestine of our gold-winged woodpecker (*Picus auratus*). This *Tænia* is remarkable for the structure of its organs of reproduction.
>
> As in the human tapeworm (*Tænia solium*), so also in this, the genital openings alternate from one articulation to the next; but in the former, and as seems generally to be the case in Tænioids, the testicles lie in the middle of each articulation. (See von Siebold, Vergleichende Anatomie der wirbellosen Thiere, p. 147; and the figure in Blanchard, Recherches sur l'organization des Vers, pl. 15, figs. 4, 7.) They were placed, on the contrary, in the tapeworm of the woodpecker, in the anterior part of the articulation, just in front of the

genital opening, filling up by a large mass of convolute spermatic canals all that part of the articulation, and thus excluding from it the uterus. Furthermore, the uterus did not consist of branched, tree-like canals (see Blanchard, l. c.), but, on the contrary, of a large number of balls, perhaps connected with each other by slender ducts. Von Siebold (l. c., p. 146, and note 23) seems to speak of a similar structure observed by him or Della Chiaje in *Tænia ocellata*, and Dujardin (Histoire naturelle des helminthes, Paris, 1845) has observed exactly the same structure of the uterus in a tapeworm of the European *Picus major*.

As in other tapeworms, the spermatozoa were very fine, filiform, of one diameter throughout, without the so-called head or body of other spermatozoa. But what was very strange, these spermatozoa were of very different lengths; some twisted, thrice or even four times as long as others. Moreover, they would readily break into pieces and were not so soft and pliable as they generally are. I saw several break into two pieces (particularly when coming out from the cirrus bag) and both pieces moved on. Whether this phenomenon occurred accidentally or whether it was a natural characteristic of these spermatozoa I am at a loss to say. No water was used in the examination, of the bad effects of which upon spermatozoa I am fully aware. In either case this is a subject worthy the investigation of physiologists, for such a power of division would imply a nature in these spermatozoa entirely different from what we have hitherto observed. Other spermatozoa present individual elements; on the contrary, those of this tapeworm would be really dividual, at least virtually, as they have the faculty of dividing and thus multiplying themselves. Not the slightest difference could be observed in activity, movement, or form between the divided portions and the whole animals, so that we may suppose that each of the divided pieces had the fructifying power as well as the others. Furthermore, the motion of these spermatozoa was extraordinary. Whilst others move in a peculiar, quick, vibratory manner, these progress much more slowly in a succession of long curves, reminding one of the motion of an eel at the bottom of a river.

This same tapeworm is also remarkable for the strange shape of its eggs. While the eggs of tapeworms generally are globular or oval, the shape of these was that of a large ball running out on both sides into tubes which terminated in balls of about half the diameter of the central one. I found these eggs in all stages of development, some containing nothing but a clear yolk, while others presented embryos with six little spines. The yolk as well as the embryo was found only in the central ball, and there also the yolk membrane terminated. Thus the lateral tubes of the egg, as well as the balls in which they terminated, are to be considered merely as excrescences and appendages of the outer (the third) coating of the egg. Similar appendages to the eggs of tapeworms have been met with previously by other observers, namely, threads running out on two sides in *Tænia infundibuliformis* and *planiceps*, by von Siebold (l. c., p. 148), and *Tænia cyathiformis*, by Dujardin (l. c., p. 568, and figured pl. 9, fig. R., 2), while von Siebold (l. c.) describes the eggs of the same worm as provided at the pointed ends of their outer pear-shaped coatings with two bladder-like appendages, which remind one more of the new form just described. Two delicate tufts, one on each side, have been observed by Meissner in *Mermis nigrescens* (Beitræge zur Anatomie und Physiologie der Gordiaceen, in von Siebold and Kölliker's Zeitschrift f. Wissensch. Zool., vol. 7; pl. 2, fig. 2), and by Siebold (l. c.) in *Tænia variabilis*. All these appendages belong to the third coating of the egg, adjoining the so-called chorion. Analogous appendages are found in the eggs of sharks and skates. Some of the embryos were hatched under my eyes, and in spite of the greatly different organization of the adult worms, their organization was seen to be throughout identical with that of the embryos of the genuine *Tænias* (those of man, dog, cat, etc.), namely, a roundish disk, containing smaller and larger granules, and provided with six little spines, disposed in three pairs, two lateral and one in front. * * *

The new genus, which we found upon the structural peculiarities mentioned above, we will call *Liga*, and the species, from its many yellowish-brown dots, *punctata*.

A full description of both genus and species, with drawings, will be given on some future occasion.

In 1858 (1858c, pp. 14, 16, 52) Weinland refers a number of times to the tapeworm from the golden-winged woodpecker, and although he does not use the name *Liga punctata* there can be no doubt that he has in mind the species which he described in 1857. Weinland (1858c, p. 52) classes the "Tænioid from the golden-winged woodpecker" in the subgenus *Dilepis*, genus *Hymenolepis*, from which fact inferences may be drawn with regard to certain characters of *Liga punctata* which were not clearly defined in the earlier paper.

The following characters are given by Weinland for the genus *Hymenolepis:* "The outer shell of the egg membranaceous; one, rarely two, rows of small hooklets on the proboscis. The hooklets much less developed than in the Sclerolepidota. Uterus consisting of ball-like blind sacs." In the subgenus *Dilepis* "the egg has two shells only; the outer shell is membranaceous, and often bears strange appendages."

By combining these data with the description given in the earlier paper we find the essential characters of *Liga punctata* to be as follows:

Head armed with one or two rows of small hooklets. Strobila with many yellowish-brown punctations. Genital pores alternate at or in front of the middle of the segment. Vas deferens[a] forming a mass of coils in the anterior portion of the segment in front of the genital pore. Uterus consisting of a large number of blind sacs, perhaps connected with one another. Eggs with two shells; outer shell membranaceous, with a tubular process at each pole terminating in a globular expansion.

Although from the more modern standpoint, Weinland's account of *Liga punctata* is rather meager, the characters given would seem sufficient to enable the species to be recognized in case it should again be met with, and I believe that there can be no reasonable doubt that certain tapeworms which I have found in the golden-winged woodpecker (*Colaptes auratus*) belong to the identical species described by Weinland. Furthermore, it appears upon comparing these specimens with Fuhrmann's (1907b, p. 521) description and figure of *Fuhrmannia brasiliensis* from *Picus*, species, Brazil, incompletely described by Parona in 1901, that the latter is of the same species.

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[a] The large mass of convolute spermatic canals in the anterior part of the segment, which Weinland (1857b) mentions, evidently represents the vas deferens, and not, as misinterpreted by Weinland, testicles.

In accordance with the International Code of Zoological Nomenclature the name *Liga punctata* is invalid, since prior to the publication of this name the species to which it belongs was referred to under the name of *Tænia punctata*, which is a homonym of *Tænia punctata* Rudolphi, 1802. This reference (Weinland, 1856a, p. 25) is as follows:

> In another and new species of tapeworm, the *Tænia punctata* Weinl., found in the golden-winged woodpecker, he had observed the embryo just hatching. The shell of the egg of the worm has two processes, each terminating in a large ball; the embryo is provided with six spines.

Tænia punctata Weinland, 1856, being a homonym, and *Liga punctata* accordingly invalid, the species takes the next available name, which is *Liga brasiliensis* (Parona, 1901).

LIGA BRASILIENSIS (Parona, 1901) Ransom, 1909.

Figs. 9–14.

Tænia punctata Weinland, 1856a, p. 25 (not *T. punctata* Rudolphi, 1802).—Braun, 1894a, p. 1143; 1900a, p. 1670.

Liga punctata Weinland, 1857b, p. 62.—Stiles, 1903hh, pp. 19, 20; 1906a, p. 62.—Fuhrmann, 1907a, p. 292; 1908a, pp. 60, 61, 169.

Fuhrmannia brasiliensis Parona, 1901b, pp. 10–11; 1901a, pp. 8–9.—Fuhrmann, 1907b, p. 521, fig. 12; 1907a, p. 292; 1908a, pp. 28, 60, 61.

Fuhrmann describes *Fuhrmannia brasiliensis* as a very small cestode, consisting when mature of only about 16 proglottids; its length scarcely 3 mm., its greatest breadth 0.5 mm. The scolex has a diameter of 0.39 mm., suckers 0.15 mm. The rostellum is armed with a double crown of hooks, which are almost exactly similar in shape. Each crown consists of 10 hooks, the larger of which measure 0.043 mm., the smaller 0.039 mm. in length. Genital pores regularly alternate. Testicles 12 to 14 at posterior border of segment. Cirrus pouch small, pyriform. Cirrus surrounded at its base by a crown of long fine spines, forming in the genital cloaca a small dark staining cone. The last segment is entirely filled with the sac-like uterus and measures 0.7 mm. in length and 0.5 mm. in breadth. Oncosphere 0.027–0.03 mm., outer membrane, 0.043 mm. in diameter. The outermost shell appears to have not yet developed.

The specimens upon which the following description is based were collected from the small intestine of a golden-winged woodpecker (*Colaptes auratus*) killed near Bowie, Maryland. They are preserved in the Helminthological Collection of the Bureau of Animal Industry, No. 4577.

The worms (fig. 9) possess from 12 to 15 segments, a number slightly less than that given by Fuhrmann, who writes that there are about 16 segments. A specimen with 12 segments measured 3 mm. in length by 0.7 mm. in width.

The head (fig. 9) is 200µ long by 400µ wide, with well-developed rostellum (fig. 10) armed with 20 hooks (fig. 11), arranged in a double crown of alternating longer and shorter hooks. The longer hooks measure 45 to 50µ in length which is practically the same size as that given by Fuhrmann. The hooks of the two rows are similar in shape and possess a long dorsal root and a short ventral root, the dorsal root and blade of the hook being about equal in length. Suckers 135µ (150µ Fuhrmann) in diameter. Segmentation begins immediately behind the head. The length of the segments gradually increases, and beginning with about the fifth segment an increase in width also takes place, the twelfth segment measuring 360µ long by 700µ wide. In still older segments the length may be greater than the width, 1 mm. and 0.6 mm., respectively. Parenchymatous tissue of the body very granular (from which apparently the name *punctata* of Weinland). Male organs become functional in sixth or seventh segment, female organs in ninth or tenth, uterus becomes functional in eleventh or twelfth segment. Genital pores

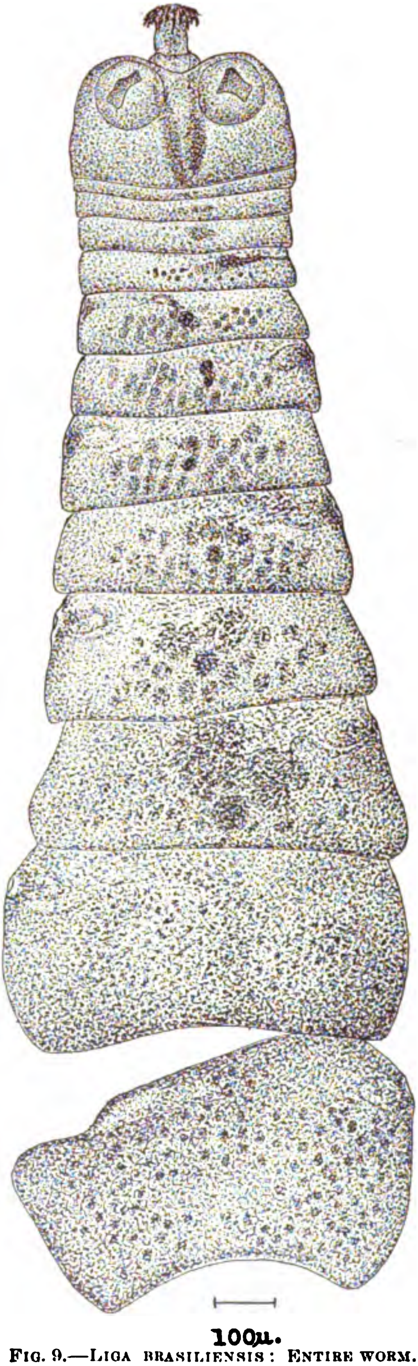

FIG. 9.—LIGA BRASILIENSIS: ENTIRE WORM.

regularly alternate in the anterior third of the segment. Male and female genital canals pass dorsal of excretory vessels and nerve.

Male reproductive organs.—Testicles (fig. 12, *t.*) about 18 (12–14 Fuhrmann) in number, oval, maximum size 80 to 100μ, located in the middle field of the posterior two-thirds of the segment, nine in each lateral half of the segment. Vas deferens (figs. 12, 13, *v. def.*) forms a mass of coils in the anterior third of the segment, beginning near the median line and extending outward nearly to the genital pore, and also describes a number of coils after entering the cirrus sac. No vesicular enlargements in any part of the vas deferens. Cirrus sac (figs. 12, 13, *c. p.*) oval, elongated, 80 to 100μ long by 40 to 55μ wide. Cirrus 40 to 50μ long, armed with highly refractile spines,

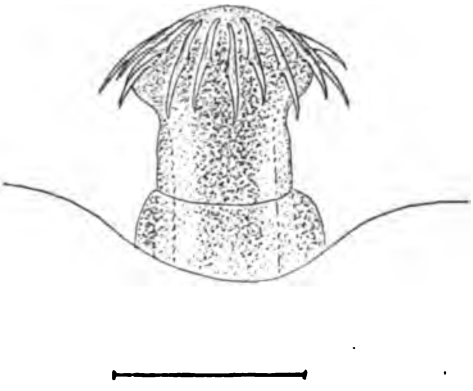

Fig. 10.—Liga brasiliensis: Rostellum, extruded.

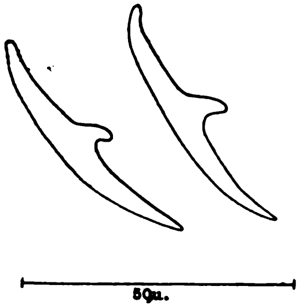

Fig. 11.—Liga brasiliensis: Hooks from rostellum.

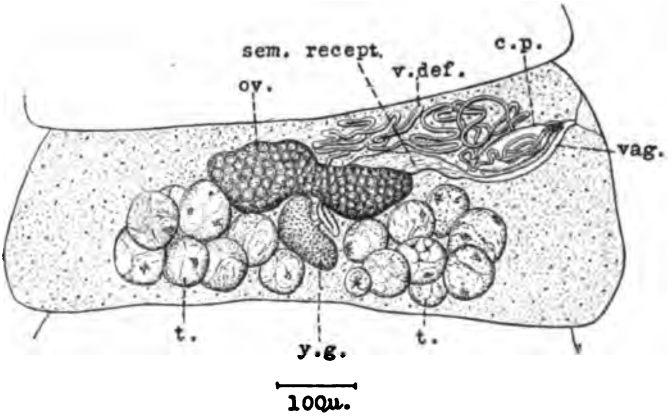

Fig. 12.—Liga brasiliensis: Sexually mature segment. *c. p.*, Cirrus pouch. *ov.*, Ovary. *sem. recept.*, Seminal receptacle. *t.*, Testicles. *vag.*, Vagina. *v. def.*, Vas deferens. *y. g.*, Yolk gland.

which in stained specimens are deeply stained and form a conspicuous cone-shaped structure in the cirrus pouch or in the genital cloaca.

Female reproductive organs.—Vagina (figs. 12, 13, *vag.*) enlarged after crossing the excretory canals, to form a seminal receptacle (figs. 12, 13, *sem. recept.*), varying greatly in size in different segments. Ovary (fig. 12, *ov.*) in central portion of segment, sac-like, faintly bilobed, somewhat elongated transversely. Yolk gland (fig. 12, *y. g.*) about 100μ in diameter, nearly round, or reniform. Shell gland small, inconspicuous. Gravid uterus (fig. 13, *ut.*) consists of a thin-walled sac with many small, incompletely separated lobules or outpocketings, filling nearly the entire middle field of the segment excepting a small anterior portion occupied by the vas deferens. Eggs (fig. 14) with a thin outer shell with a tubular process at each

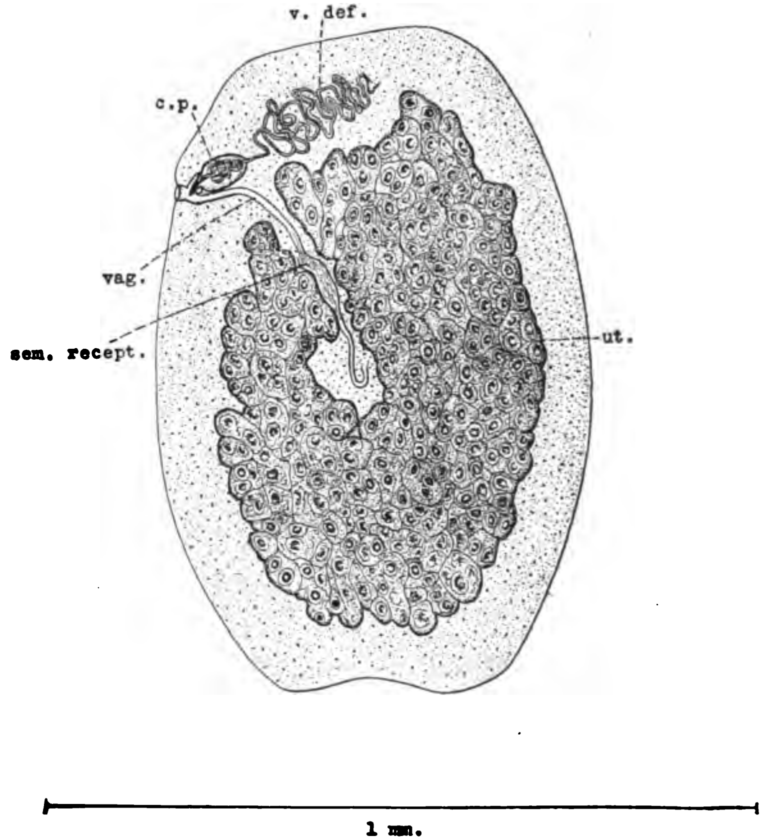

FIG. 13.—LIGA BRASILIENSIS: GRAVID SEGMENT. *c. p.*, CIRRUS POUCH. *sem. recept.*, SEMINAL RECEPTACLE. *ut.*, UTERUS. *vag.*, VAGINA. *v. def.*, VAS DEFERENS.

pole terminating in a small globular expansion. Length of outer shell, including processes, 120 to 125μ; central portion 50μ long by 38 to 40μ wide; diameter of tubular processes 3 to 4μ, of globular expansion 10 to 17μ. Inside of the outer shell a second thin, well-defined shell, spherical, 33 to 36μ in diameter. Oncosphere 26μ in diameter.

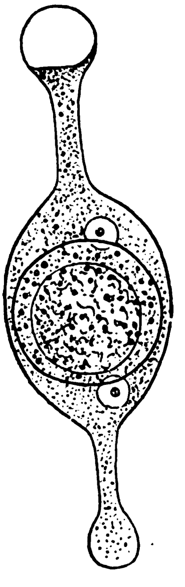

FIG. 14.—LIGA BRASILIENSIS: EGG.

Genus RHABDOMETRA Kholodkovski, 1906.

(For generic diagnosis see p. 86.)

RHABDOMETRA NULLICOLLIS, new species.

Figs. 15–22.

This species has been found in the sagecock (*Centrocercus urophasianus*) and in the sharp-tailed grouse (*Pedioecetes phasianellus columbianus*). The type-specimens (No. 6018, U. S. Nat. Mus.) were collected from the first-named host in Colorado.

External anatomy.

The various specimens of this species which have been studied measured 50 to 100 mm. in length by 2 to 2.5 mm. in maximum width. The head (figs. 15, 16) is obtusely pointed anteriorly, 560 to 650μ wide, about 360μ thick, and 280 to 330μ long, without rostellum. The suckers are 140 to 160μ in diameter. A neck is absent, segmentation beginning immediately behind the head. The segments are at first of the same width as the head, or slightly wider, and gradually increase in width, finally decreasing again at the posterior end of the strobila. The first segments are less than 20μ in length, sexually active segments measure 330μ in length by 1.25 mm. in width, the largest segments measure 1.25 mm. in length by 2 to 2.5 mm. in width, and the final segments 2.8 mm. in length by 1.3 mm. in width. The posterior border of each segment overlaps the anterior end of the following segment only very slightly, and is but slightly wider than the anterior border, so that the segments are nearly quadrate in shape.

The sexual pores are irregularly alternate, located in the anterior third of the segment.

Internal anatomy.

Nervous system.—The lateral longitudinal nerves (fig. 18, *l. n.*) are large and well developed, located in the lateral portions of the segment inside the inner layer of longitudinal muscles.

Musculature.—The longitudinal muscles (fig. 18) are arranged in numerous small bundles disposed in two layers close together, and a considerable distance from the surface of the segment. Dorsoventral fibers are numerous. Transverse fibers are comparatively few, in relation with the outer and inner sides of the inner longitudinal muscles which they cross at right angles.

Excretory system.—The excretory system is well developed. The dorsal (fig. 18, *d. ex.*) and ventral canals (fig. 18, *v. ex.*) are located a considerable distance mediad from the lateral nerves. The ventral canal is much the larger, measuring in places 80μ in diameter, whereas the dorsal canal measures less than 8μ. The ventral canals are connected by a transverse canal in the posterior portion of each segment, and also send off anastomosing branches which run among the various organs of the segment, and also form a plexus, which extends laterally on each side of the segment as far as the lateral longitudinal nerve.

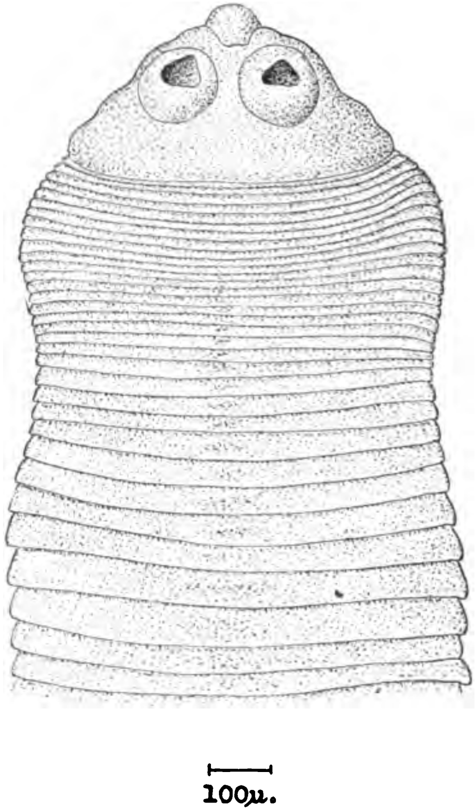

FIG. 15.—RHABDOMETRA NULLICOLLIS: HEAD AND ANTERIOR PORTION OF STROBILA.

The vagina and cirrus pouch pass between the dorsal and ventral excretory canals and dorsal of the lateral nerve.

Male reproductive organs.—The testicles (figs. 17, 18, 20, *t.*) are about 60 in number, arranged in two layers in the middle field, in the posterior portion of the segment. They measure from 80 to 100μ in diameter when fully developed. The mass of testicles is hollowed out in front, and this depression is occupied by the female genital glands. The vas deferens (figs. 20, 21, *v. def.*) forms a mass of coils in the anterior third of the segment extending from the median line to the base of the cirrus pouch. The cirrus pouch (figs. 17, 19, 21, 22, *c. p.*) is elongated, broadest near the base and tapering toward its outer end. It measures 350 to 380μ in length by 80 to 100μ in thickness. It is covered with a layer of muscle fibers interlacing and crossing diagonally, forming a sort of basket work (fig. 19). In the distal three-fifths of the pouch this layer is very thick, but is thin in the proximal or basal portion of the pouch. The cirrus (figs. 19, 20, *cir.*) is from 250 to 350μ in length, about 10μ in diameter when evaginated, with a lumen about 2μ in diameter, and is armed with short spines 2 to 3μ long. A number of slender muscles, which extend from its inner end to attach to the distal portion of the pouch, serve as protractors. The portion of the vas deferens which lies within the cirrus pouch possesses a thick muscular wall. From the base of the cirrus pouch a prominent retractor muscle (fig. 19, *retr.*) extends diagonally inwards and forwards to the anterior end of the segment near the median line. The

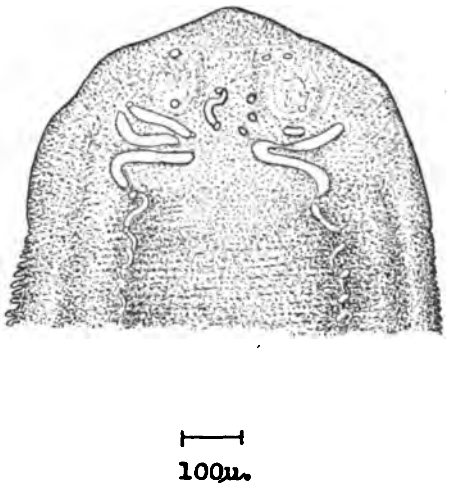

FIG. 16.—RHABDOMETRA NULLICOLLIS: HEAD AND ANTERIOR PORTION OF STROBILA, MEDIAN HORIZONTAL SECTION.

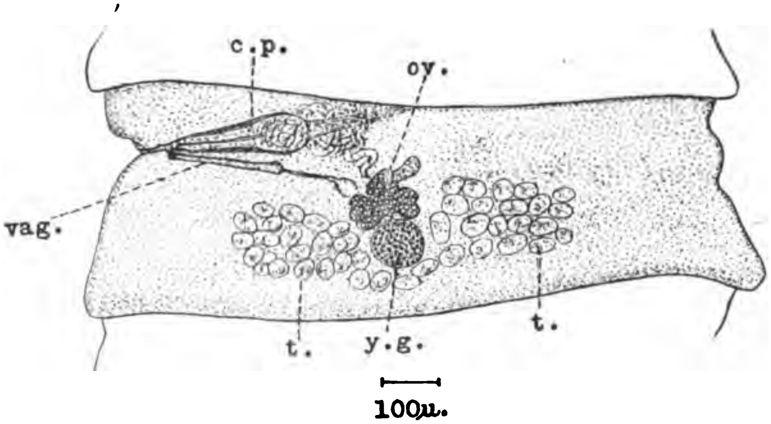

FIG. 17.—RHABDOMETRA NULLICOLLIS: SEXUALLY MATURE SEGMENT. *c. p.*, CIRRUS POUCH. *ov.*, OVARY. *t.*, TESTICLES. *vag.*, VAGINA. *y. g.*, YOLK GLAND.

axis of the cirrus pouch is nearly transverse in younger segments. with its inner end slightly tilted forward, but as the segments become older the cirrus pouch becomes more and more oblique.

Female reproductive organs.—The vagina (figs. 17, 18, 20, 21. 22, *vag.*), which opens into the genital sinus immediately behind the male opening, has three distinct portions. The first is very short with a narrow lumen and is surrounded by a spherical muscle bulb 25 to 30μ in diameter which serves as a sphincter (fig. 20, *sph. vag.*). The second portion is 250 to 300μ long, and possesses a muscular wall by the expansion or contraction of which the size of the lumen may be varied; this portion is lined with closely set cilia-like projections 8 to 10μ long. The third portion has a thin membranous wall, and its lumen is at first very narrow, about 2μ, but toward its inner end it swells out to form a seminal receptacle (figs. 18, 20, *sem. recept.*) about 50μ in diameter and 75 to 100μ long.

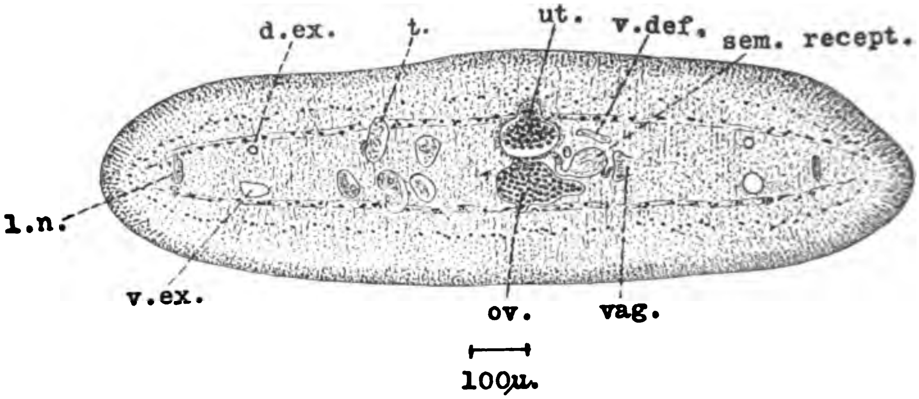

FIG. 18.—RHABDOMETRA NULLICOLLIS: SEXUALLY MATURE SEGMENT, TRANSVERSE SECTION. *d. ex.*, DORSAL EXCRETORY VESSEL. *l. m.*, NERVE CORD. *ov.*, OVARY. *sem. recept.*, SEMINAL RECEPTACLE. *t.*, TESTICLE. *ut.*, UTERUS. *vag.*, VAGINA. *v. def.*, VAS DEFERENS. *v. ex.*, VENTRAL EXCRETORY VESSEL.

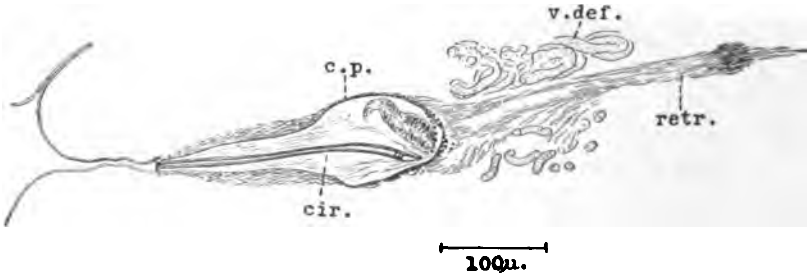

FIG. 19.—RHABDOMETRA NULLICOLLIS: SECTION THROUGH CIRRUS POUCH. *cir.*, CIRRUS. *c. p.*, CIRRUS POUCH. *retr.*, RETRACTOR OF CIRRUS POUCH. *v. def.*, VAS DEFERENS.

The ovary (figs. 17, 18, *ov.*) is small, compact, and but slightly lobed. At its maximum of development it does not exceed 175μ

in width. It is located about in the center of the segment nearer the ventral than the dorsal surface, and in contact with the inner side of the inner longitudinal muscle layer. Immediately behind

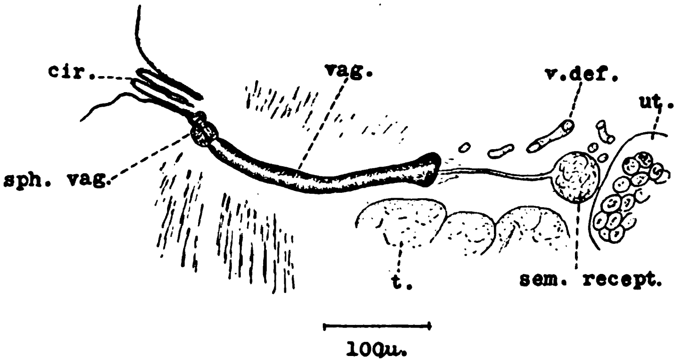

Fig. 20.—Rhabdometra nullicollis: Section through vagina, seminal receptacle, and extruded cirrus. *cir.*, Cirrus. *sem. recept.*, Seminal receptacle. *sph. vag.*, Sphincter of vagina. *t.*, Testicles. *ut.*, Uterus. *vag.*, Vagina. *v. def.*, Vas deferens.

the ovary is the rounded yolk gland (fig. 17, *y. g.*) which measures 100 to 130µ in diameter. Dorsal of the yolk gland is the shell gland slightly smaller. The uterus (figs. 18, 20, 21, 22, *ut.*) develops immediately in front of and dorsal of the ovary, as a simple sac-like organ. As the uterus develops, growing anteriorly and posteriorly, the ovary disappears. The parenchyma in front of the uterus becomes dense and fibrous, and develops into a prominent para-

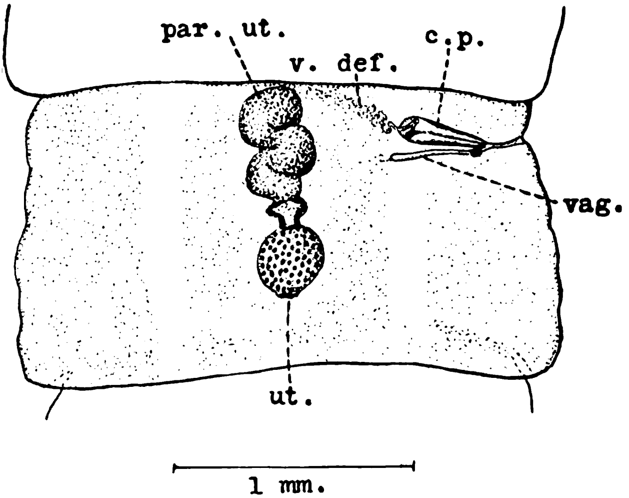

Fig. 21.—Rhabdometra nullicollis: Gravid segment. *c. p.*, Cirrus pouch. *par. ut.*, Para-uterine organ. *ut.*, Uterus. *vag.*, Vagina. *v. def.*, Vas deferens.

uterine organ (figs. 21, 22, *par. ut.*) which behind is in immediate relation with the anterior end of the uterus. The para-uterine organ when fully developed extends forward to the anterior end of the segment in a slightly tortuous course. Its wall is 5 to 10μ thick, composed in large part of muscular elements, and its cavity before the eggs pass forward into it from the uterus is filled with a finely fibrous mass. The eggs are oval, with a thin outer membrane 36 to 40μ in diameter, a thicker middle shell 24 to 27μ in diameter, and a thin inner membrane closely enveloping the oncosphere, which measures 18μ in diameter. When the eggs first enter the uterus they are surrounded by a single membrane, the others developing later.

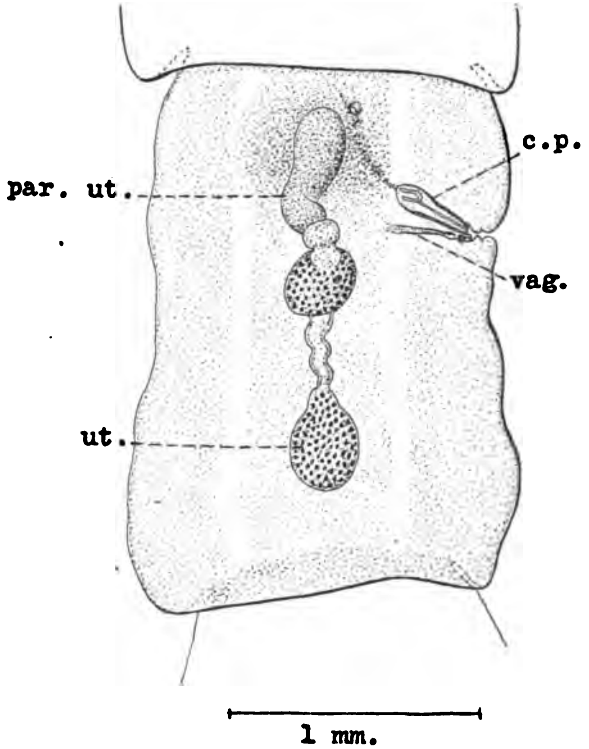

FIG. 22.—RHABDOMETRA NULLICOLLIS: GRAVID SEGMENT. *c. p.*, CIRRUS POUCH. *par. ut.*, PARA-UTERINE ORGAN. *ut.*, UTERUS. *vag.*, VAGINA.

RHABDOMETRA SIMILIS, new species.

Figs. 23–26.

This species is based on specimens (from the collection of H. B. Ward, deposited in the U. S. National Museum Helminthological Collection, No. 7236) collected from a rain crow (*Coccyzus americanus*) in Nebraska. No heads were present in this material, but the anatomy of the strobila shows the affinities of this species with the genus *Rhabdometra.*

External anatomy.

The length of this species, so far as could be judged from the specimens examined, which were broken into small pieces, is about 75 mm. The maximum breadth of the strobila is 1.5 mm. The first segments are very short (80 μ) and about 0.5 mm. broad, the oldest segments slightly longer than broad, 0.95 to 1 mm. long by 0.85 to 0.95 mm. broad. The posterior border of each segment overlaps the anterior portion of the following segment only very slightly. The segments are nearly as broad at the anterior border as at the posterior border and are hence nearly quadrate in shape.

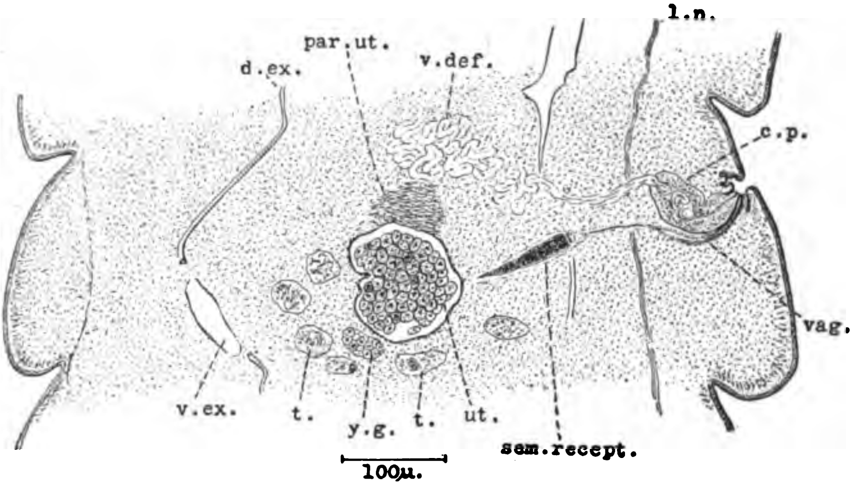

Fig. 23.—Rhabdometra similis: Sexually mature segment becoming gravid, horizontal section. *c. p.*, Cirrus pouch. *d. ex.*, Dorsal excretory vessel. *l. n.*, Nerve cord. *par. ut.*, Para-uterine organ. *sem. recept.*, Seminal receptacle. *t.*, Testicles. *ut.*, Uterus. *vag.*, Vagina. *v. def.*, Vas deferens. *v. ex.*, Ventral excretory vessel. *y. g.*, Yolk gland.

The genital pores are irregularly alternate, located in the anterior half of each segment.

Internal anatomy.

Nervous system.—The usual lateral longitudinal nerves (fig. 24, *l. n.*) are present and are located a short distance beyond the most lateral bundles of the inner longitudinal muscle layer, and inside of the outer longitudinal layer, about equidistant from the lateral border of the segment and the longitudinal excretory canals.

Musculature.—The longitudinal muscles are arranged in two layers, an outer layer of numerous small bundles and an inner layer of larger bundles which are far apart and not over 20 to 24 in number.

Dorso-ventral fibers are fairly numerous throughout the segment, but transverse fibers are not present.

Excretory system (figs. 23, 24, *d. ex.*, *v. ex.*).—In sexually active segments the ventral excretory canals measure from 25 to 50μ in diameter, the dorsal canals 8 to 10μ. The latter are located dorsal of the ventral canals in about the same vertical longitudinal plane. In the posterior portion of each segment the ventral canals are connected by a transverse canal.

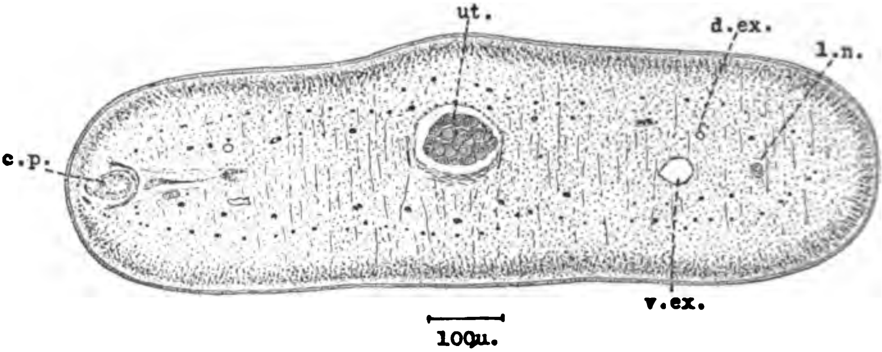

FIG. 24.—RHABDOMETRA SIMILIS: SEXUALLY MATURE SEGMENT, BECOMING GRAVID, TRANSVERSE SECTION. *c. p.*, CIRRUS POUCH. *d. ex.*, DORSAL EXCRETORY VESSEL. *l. n.*, NERVE CORD. *ut.*, UTERUS. *v. ex.*, VENTRAL EXCRETORY VESSEL.

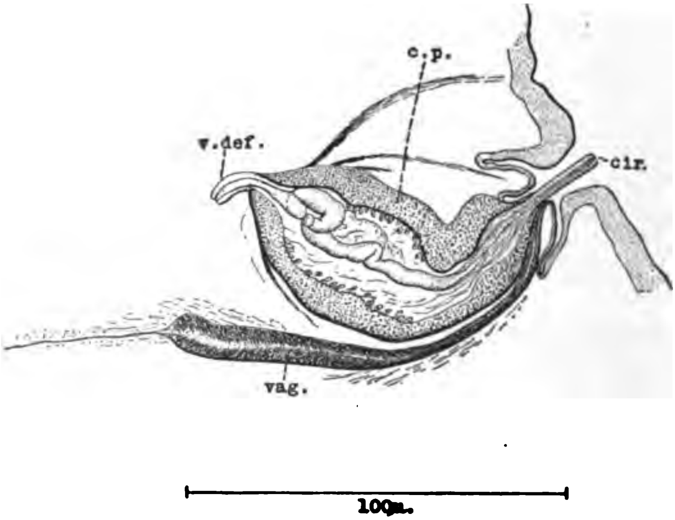

FIG. 25.—RHABDOMETRA SIMILIS: SECTION THROUGH CIRRUS POUCH AND VAGINA. *cir.*, CIRRUS. *c. p.*, CIRRUS POUCH. *vag.*, VAGINA. *v. def.*, VAS DEFERENS.

The vagina and vas deferens pass between the excretory canals and dorsal of the lateral nerve.

Male reproductive organs.—The testicles (fig. 23, *t.*), numbering 16 to 20, are located in the posterior third of the segment, are oval in shape, and measure about 50μ in diameter. The vas deferens (fig. 23, *v. def.*), formed by the junction of efferent canals from the testicles, extends forward near the median line to the anterior end of the segment, then turns and passes outward and backward in a tortuous course toward the cirrus pouch. The cirrus pouch (figs. 23, 24, 25, *c. p.*) is comparatively small, measuring but 80 to 90μ in length by 40μ in diameter. The outer muscular wall is rather thick (8 to 10μ) compared to the size of the pouch. The cirrus pouch is not supplied with a retractor muscle, but numerous muscle fibers extend from the base of the pouch outward to attach to the cuticula surrounding the genital pore. The cirrus (fig. 25, *cir.*) in the retracted condition is very slender (2μ) and is apparently without spines. When evaginated it measures about 4μ in diameter.

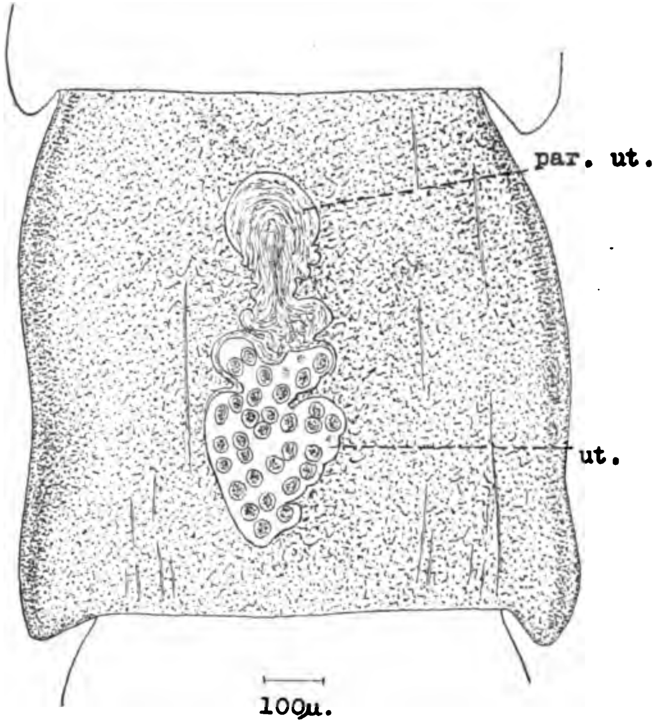

FIG. 26.—RHABDOMETRA SIMILIS: GRAVID SEGMENT. *par. ut.*, PARA-UTERINE ORGAN. *ut.*, UTERUS.

Female reproductive organs.—The vagina (figs. 23, 25, *vag.*), which opens into the genital cloaca immediately behind the cirrus, is at first rather thick-walled. It has no definite sphincter. Before crossing the lateral nerve the vagina becomes a thin-walled tube with narrow lumen, and after passing the excretory canals is dilated to form an elongated seminal receptacle (fig. 23, *sem. recept.*) which extends first inward toward the median line, and then diagonally backward and inward toward the female glands, which are located in the median line close to the posterior border of the segment.

The ovary, which is very small and compact, measures about 100μ in diameter and is near the median line in the ventral half of the segment near the posterior border. Ventral of the ovary is the yolk gland, about 80μ in diameter. A definite shell gland was not seen.

The uterus (figs. 23, 24, 26, *ut.*) develops immediately in front of the ovary in the median line. It is a simple sac-like organ slightly irregular but somewhat spherical in shape. In front of the uterus the parenchyma becomes modified to form a para-uterine organ (fig. 26, *par. ut.*) with bulbous anterior end, which extends forward in the median line nearly to the anterior border of the segment. The contents of this organ before the eggs have entered it present the usual fibrous appearance.

The eggs, which are oval in shape, have three membranes, an outer one, very thin, about 45μ in diameter, a thicker prominent middle membrane 30 to 38μ in diameter, and a thin inner membrane closely investing the oncosphere, which measures 25 to 30μ in diameter.

Genus ANONCHOTÆNIA Cohn, 1900.

(For generic diagnosis, see p. 86.)

ANONCHOTÆNIA GLOBATA (Linstow, 1879).

Fig. 27.

Some specimens of tapeworms (No. 3027, Helminthological Collection, Bureau of Animal Industry) collected in Maryland from *Dendroica striata* and others (No. 5955, Helminthological Collection, U. S. Nat. Mus.) collected in Maryland from *Melospiza melodia* agree very closely with the published descriptions of *Anonchotænia globata*, and I have accordingly identified them as belonging to this species.

External anatomy.

The length of these specimens is from 20 to 30 mm., and the maximum breadth is about 1 mm. The head is rounded, without rostellum, and measures 500 to 650μ in diameter. The suckers are about 230μ in diameter. Cohn (1901b) states that a neck is absent, segmentation beginning immediately behind the head. In the specimens which I have examined, however, there is an unsegmented region immediately behind the head measuring 0.6 mm. in width by 1.5 to 2 mm. in length. Fuhrmann (1908c, p. 625) has also noted that the neck is relatively long. The first segments are very short; the final segments nearly as long as broad. The genital pores are irregularly alternate at about the middle of the segment. The genital sinus is deep and narrow.

Internal anatomy.

The ventral excretory canals are connected in the posterior portion of each segment by a transverse canal.

The longitudinal muscles are arranged in two concentric layers, the inner layer (*int. musc.*) consisting of about 50 bundles, the outer (*ext. musc.*) of more numerous smaller bundles. Well-defined transverse fibers are present just inside the inner longitudinal layer. Dorso-ventral fibers are very weakly developed.

The sexual canals pass on the ventral side of the excretory vessels and the nerve.

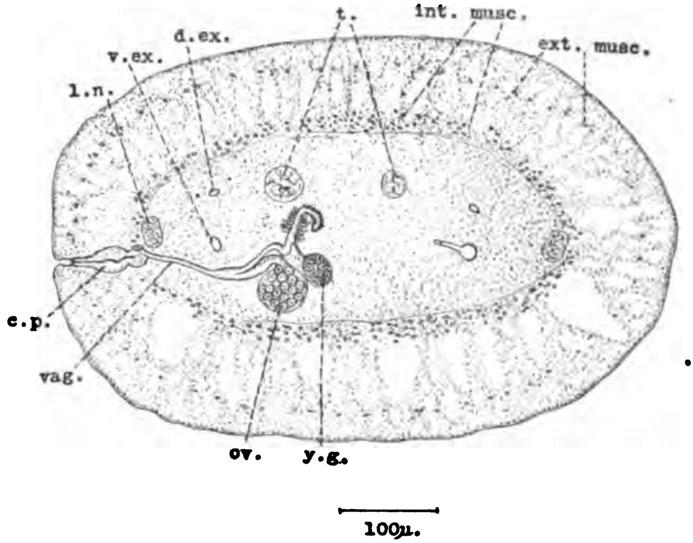

FIG. 27.—ANONCHOTÆNIA GLOBATA: SEXUALLY MATURE SEGMENT, TRANSVERSE SECTION. *c. p.*, CIRRUS POUCH. *d. ex.*, DORSAL EXCRETORY VESSEL. *ext. musc.*, OUTER LONGITUDINAL MUSCLES. *int. musc.*, INNER LONGITUDINAL MUSCLES. *l. n.*, NERVE CORDS. *ov.*, OVARY. *t.*, TESTICLES. *vag.*, VAGINA. *v. ex.*, VENTRAL EXCRETORY VESSEL. *y. g.*, YOLK GLAND.

Male reproductive organs.—The testicles (*t.*) are five in number located toward the dorsal surface in the anterior portion of the segment. They measure when fully developed 30 to 40μ in diameter. The vas deferens is somewhat tortuous, without, however, forming a mass of coils, and is without vesicular enlargements. The cirrus pouch (*c. p.*) broadest at the base and tapering toward the end, measures from 70 to 80μ in length by 25μ in diameter. Cohn describes the cirrus pouch as short, club-shaped, and "recht muskulös." In my specimens the outer wall of the pouch is thin, with weakly developed musculature.

Female reproductive organs.—The vagina (*vag.*) passes inwards parallel with the cirrus pouch, and in older segments after crossing the excretory canals dilates to form a small seminal receptacle.

The yolk gland (*y. g.*) is spherical about 40μ in diameter located in the posterior part of the segment about in the median line. The ovary (*ov.*) is a simple sac-like organ, spherical in shape, about 60μ in diamater, and is in close relation with the yolk gland on the side toward the genital pore and closer to the ventral surface than the yolk gland. The uterus develops immediately in front of and dorsal of the ovary and becomes a rounded simple sac-like organ. In front of the uterus and in immediate relation with it a para-uterine organ develops. The outer wall of the para-uterine organ is made up of fibers running in a circular direction. Its contents have in some cases a granular, in others a finely fibrous appearance. The uterus and para-uterine organ, before the eggs have left the uterus, together form an ovoid structure occupying most of the median field of the segment. In the specimens which I have examined, this structure is placed diagonally in the segment, the uterus posterior toward the side of the segment on which the genital pore is located, and the para-uterine organ toward the opposite anterior corner, except in contracted segments, in which the axis of uterus and para-uterine organ may be transverse.

The eggs are few in number and spindle shaped. The oncosphere measures from 20 to 25μ in diameter. It is surrounded by two membranes, an inner membrane prolonged at each pole into a long, slender process, with finely granular contents and an outer membrane 30 to 36μ in diameter, prolonged at each pole into a long pointed process, wihin which lies the prolongation of the inner membrane.

Genus HYMENOLEPIS Weinland, 1858.

(For generic diagnosis see p. 91.)

HYMENOLEPIS CANTANIANA (Polonio, 1860) Ransom, 1909.

Figs. 28, 29.

Tænia cantaniana Polonio, 1860b, pp. 21–22.
(?*Davainea*) *cantaniana* (Polonio) Blanchard, 1891t, pp. 439–440.
Davainea oligophora Magalhães, 1898c, pp. 445–449, figs. 1–6.
Davainea cantaniana (Polonio) Railliet and Lucet, 1899a, p. 146.

This species, which occurs in turkeys, chickens, pheasants (*Phasianus colchicus*), and peafowls (a host hitherto unrecorded), is one concerning which there has been considerable discussion.

It was originally described by Polonio (1860b, pp. 21–22). His description translated reads as follows:

> *T. cantaniana* Polonio. Head globose, umbonate in the center; suckers placed at equal intervals about the major circumference of the head; neck absent;

body increased in size posteriorly, with the first segments campaniform, following segments campaniform trapezoidal imbricate; genital pores marginal. Length, 13 mm.

Habitaculum: *Meleagris gallopavo*, intestine, October, Padua (Polonio).[a]

In a second paper Polonio (1860a, p. 221) gave a figure of the species.

Blanchard (1891t, pp. 439–440) looked upon this form as a possible member of the genus *Davainea*, and from Polonio's figure deduced the following characters:

Suckers large and round; the head seems to be surmounted by a very short rostellum, probably retractile. The neck is quite long, distinctly separated from the head. Segments number about 60. The genital pores are unilateral; cirrus pouch is visible in the twenty-sixth to the forty-fifth segment; the forty-sixth to sixtieth segments are filled with eggs, which, so far as may be judged from the figure, are scattered and isolated as in *Davainea proglottina*.

Stiles (1896f, p. 57) considers that Polonio's description and figure are insufficient to allow the recognition of the species, and would therefore ignore the species entirely.

In 1898 Magalhães (1898c, pp. 445–449, figs. 1–6) described as a new species *Davainea oligophora*, a tapeworm found in chickens in Brazil. His description may be summarized as follows:

Length, 1.73 to 3.2 mm.; width, 170 to 390μ. Head relatively large, 85 to 108μ long by 51 to 108μ wide, with a small rostellum armed at its base with a crown of numerous small hooks, which are very instable and usually absent. The form of these hooks is that of a hammer with recurved beak. The suckers are almost circular, slightly elliptical, measuring 61 to 72μ in longitudinal diameter by 43 to 54μ in transverse diameter. They are armed with three to four circular rows of little hooks, which are very instable. The neck is short, at times even lacking, and measures 16 to 18μ long by 51 to 90μ wide. The segments number from 45 to 75, much wider than long, with posterior borders somewhat longer than the anterior borders. The length of the segments gradually increases from 20μ in the first segments to 100μ in the final segments, and the width from 80 to 100μ in the first segments to 300 to 390μ in the final segments. The sexual pores are unilateral, located one in the anterior portion of each segment. The cirrus is very small, cylindrical, apparently provided with few small spines. A seminal vesicle [misinterpretation of the seminal receptacle] is very apparent in the posterior half

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[a] *T. cantaniana* Polonio. Caput globosum, centro umbonatum; acetabulis cruciatim oppositis ob majorem capitis circulum; collum nullum; corpus retrorsum dilatatum, articulis supremis campanæformibus, sequentibus campanæformibus imbricatis trapezoidalibus; aperturæ genitales marginales. Long. 0.013.
Habitaculum: *Meleagris gallopavo*, in intestina, Octobri, Patavi (Polonio).

of the strobila, especially in the last 15 to 25 segments. This organ, which is located in the region of the genital pore, is ampulliform, ellipsoidal, and filled with spermatozoa; from it may be traced the long sinuous vas deferens. The last three to eight segments contain fully developed eggs, which are few in number. They seem to be scattered in the parenchyma or contained in a cavity which has pushed aside the parenchyma, and they so fill the segment that no other structures are visible except the seminal vesicle [receptacle]. They are spherical, with three envelopes, and measure 45 to 50μ in diameter. The outer membrane is smooth and transparent; between it and a second membrane of double contour is a granular mass. The third membrane is that which immediately surrounds the oncosphere. The oncosphere measures 25 to 30μ in diameter; its hooks, 18μ in length; the diameter of the second membrane is 32μ.

Railliet and Lucet (1899a, pp. 144–146) have reported the discovery of tapeworms in turkeys which they consider identical with *Tænia cantaniana*. These worms present the following characters: Length, 1.9 to 3.2 mm.; maximum width, 200 to 320μ. Strobila consists of 50 to 88 segments. Eggs fully formed in the last 6 to 8 segments, also apparent in less fully developed condition in preceding segments, so that the last 15 to 18 segments may be looked upon as gravid. The eggs are spherical with three envelopes, the internal and external one the thicker. The external envelope has a diameter of 54 to 57μ, the middle 39 to 42μ; the internal one surrounding the oncosphere is 29 to 30μ in diameter. The hooks of the oncosphere are 12 to 13μ in length.

These authors are of the opinion that *Davainea oligophora* Magalhães is identical with *Tænia cantaniana* Polonio in view of the striking similarity of the figures of Polonio and Magalhães.

Magalhães (1899b, pp. 480–482) refused to accept the view of Railliet and Lucet on the ground that Polonio's description is too incomplete to give the species *Tænia cantaniana* any standing. Contrary to the opinions of Stiles and Magalhães, it seems to me that Railliet and Lucet are correct in considering *Tænia cantaniana* a recognizable species, and I believe that the forms which I have studied are sufficiently similar to Polonio's description and figure to justify their identification as *Tænia cantaniana*. They also agree so closely with Magalhães's description of *Davainea oligophora* that there is little doubt of their identity with that species.

The lack of hooks in all specimens which I have examined is one point of difference from *Davainea oligophora*, but as Magalhães found hooks in but few cases and states that they are very instable and usually absent, this difference is not very remarkable. In other respects the head is entirely like that of *Davainea oligophora*, though I have found it slightly larger than described by Magalhães. There is almost perfect correspondence in the characters of the strobila so far as may be determined from Magalhães's description. The structure which Magelhães interprets as a seminal vesicle corresponds to the seminal receptacle in my specimens. The eggs of the two forms agree in size, number, arrangement, and in all respects except the size of the hooks of the oncosphere, a difference which, on account of the small size of these structures and the consequent liability of error in measurement, can not be considered of great importance.

The species which I have identified as *Tænia cantaniana* has been found several times in this country in chickens and once in a peafowl. After brief study it became evident that it belonged in the genus *Hymenolepis* and not in *Davainea*, where it has been commonly placed. The following description is based on specimens in the collection of the Bureau of Animal Industry, Nos. 4109, 4198, 4569, 14554, and 14814 from chickens, Maryland and District of Columbia, No. 14423 from a peafowl, District of Columbia, and No. 2761, collected from a turkey in France by Railliet and determined by him as *Tænia cantaniana.*

External anatomy.

The specimens (fig. 28) which I have examined vary in length from 2 to 12 mm. The maximum breadth is about 0.4 mm. The head measures 120 to 160μ in width and thickness, by 100 to 120μ in length.

The rostellum is rudimentary, an elongated sac-like structure in the central axis of the head, 80μ long by 35μ in diameter, into the anterior end of which is a deep, narrow invagination with cuticular lining 30 to 40μ in depth by 4 to 6μ in diameter.

The suckers measure 60 to 70μ in diameter. In none of the specimens studied, including some which were very young and immature, was there any trace of hooks either upon the rostellum or suckers. The neck is 80 to 90μ wide by 100 to 130μ long.

The width of the strobila gradually increases from the neck toward the posterior end, near which it reaches the maximum.

The segments are considerably broader than long throughout the strobila, the posterior angles project but slightly, and there is no overlapping of the posterior border of one segment over the anterior portion of the next following segment. A strobila 6.5 mm. long consisted of about 100 segments, of which the posterior 13 contained fully developed eggs. In the widest portion of this strobila the segments measured 80μ in length by 250μ in width. A strobila 8 mm. in length consisted of about 215 segments, of which the posterior 16 contained fully developed eggs. In the widest portion of this strobila the segments were 60 to 70μ long and 300μ wide. Segments

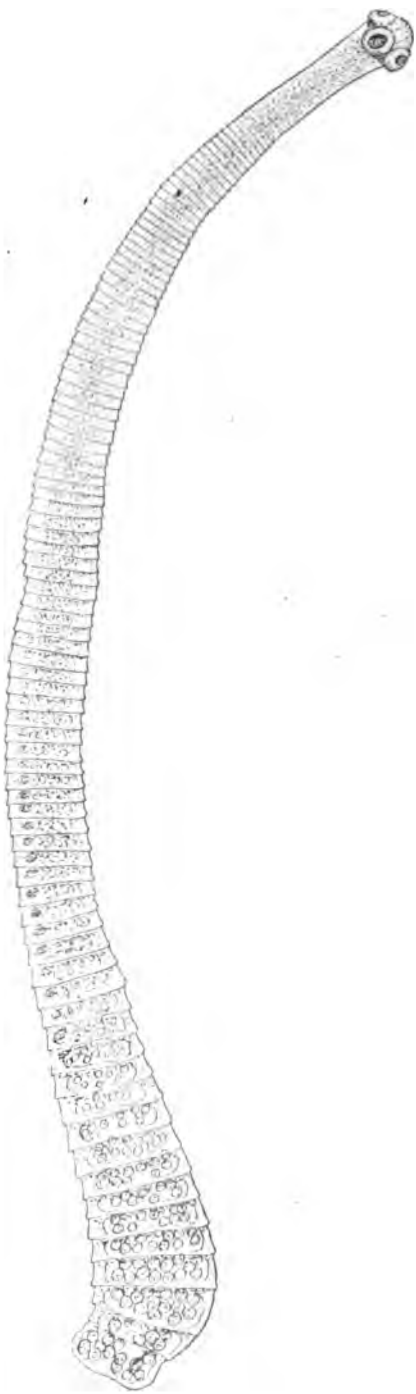

FIG. 28.—HYMENOLEPIS CANTANIANA: ENTIRE WORM. × 60.

2.5 mm. behind the head in which the male organs had just reached the functional stage measured 30μ in length by 120μ in width.

The genital pores are unilateral on the right-hand margin of the strobila, located slightly in front of the middle of each segment.

Internal anatomy.

The cirrus pouch and seminal vesicle are dorsal of the excretory vessels.

Male reproductive organs.—The testicles are three in number, dorsally located one on the right-hand side and two on the left-hand side of the segment. They reach a maximum size of 25μ in diameter. A seminal vesicle is present in the anterior portion of the segment near the median line; it attains a size of 25 to 45μ in diameter.

The cirrus pouch is elongated, tapering toward its outer end, and measures 75 to 95μ in length by 12 to 18μ in diameter. Its inner end is near the anterior border of the segment and extends beyond the median line in the younger segments. The outer wall of the pouch is thin without definite muscle elements. Within the pouch the vas deferens is enlarged to form a seminal reservoir, which occupies more or less of the cavity of the pouch.

Female reproductive organs.—In sexually mature segments the vagina is swollen to form a prominent seminal receptacle located near the right-hand border of the segment ventral of the cirrus pouch, oval in shape, and attaining a maximum of 30 to 35μ by 45 to 50μ in width and length.

The ovary when fully developed is transversely elongated, extending laterally as far as the excretory canals and measuring 135μ in its longest dimension. It extends forward to the anterior border of the segment, but does not reach the posterior border. In the median line behind the ovary is the small rounded yolk gland, which measures about 20μ in diameter.

The uterus develops as a simple sac on the ventral side of the ovary, and the latter rapidly degenerates after the appearance of the former. When fully developed the uterus occupies practically the entire segment, and as its wall becomes folded inward in various places its cavity is divided into a number of incompletely separated chambers. The number of eggs in the gravid segment is small, 18 to 20, but on account of the large size which they finally attain the cavity of the uterus is fully occupied.

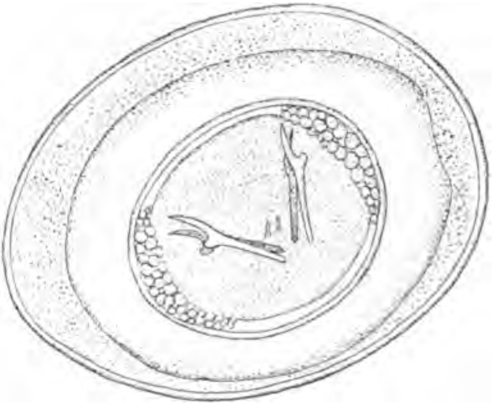

FIG. 29.—HYMENOLEPIS CANTANIANA: EGG.

When they first enter the uterus the eggs have but a single thin membrane and measure but 20μ in diameter. Later other membranes are developed, and the egg (fig. 29) in the final stage of development possesses two well-defined shells, an inner one 27 to 35μ in diameter and an outer one 45 to 60μ in diameter. Between the outer and inner shell is an intermediate finely granular layer limited by a very thin membrane internally and externally. The oncosphere measures 22 to 25μ in diameter with hooks 13 to 14μ in length.

Genus DIORCHIS Clerc, 1903.

(For generic diagnosis see p. 98.)

DIORCHIS ACUMINATA (Clerc, 1902) Clerc, 1903.

Figs. 30–36.

Drepanidotænia acuminata CLERC, 1902a, p. 659, figs. 3, 4.
Diorchis acuminata (CLERC, 1902) CLERC, 1903, pp. 248, 249, 255, 281–284, pl. 8, fig. 13; pl. 9, fig. 25; pl. 11, figs. 78, 79.
Diorchis accuminata CLERC, 1903, p. 249 (misprint for *D. acuminata*).
Tænia acuminata CLERC, 1903, p. 283

Specimens of a tapeworm (from the collection of H. B. Ward, deposited in the U. S. National Museum Helminthological Collection, No. 7237) collected in Nebraska from *Fulica americana* apparently belong to the species *Diorchis acuminata.*

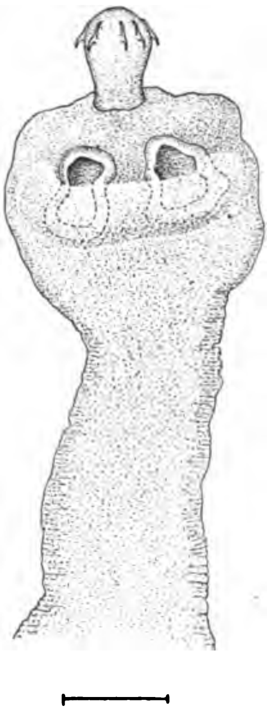

FIG. 30.—DIORCHIS ACUMINATA: HEAD AND ANTERIOR PORTION OF STROBILA.

External anatomy.

These specimens measure 35 mm. in length by 0.65 mm. in maximum breadth. The final segments were not yet gravid, and it is consequently evident that the full-grown worm may be considerably larger than indicated by the above figures.

The head (figs. 30, 31) measures 160µ in length by 225 to 235µ in width. The rostellum is cylindrical when protruded, slightly broader at the tip than at the base, measuring 100µ in length by 50µ in diameter at the base and 70µ in diameter at the tip. It is armed with 10 hooks (fig. 32), with long dorsal and short ventral root and measuring 38µ in length, the dorsal root being 25µ and the prong 13µ in length. The suckers are about 80µ in diameter and are armed with minute spines less than 5µ in length, set close together in diagonal rows covering the entire surface of the sucker.

Segmentation begins very close behind the head, and in this region the strobila is of about the same breadth as the head. The breadth then becomes reduced to about 150µ and afterwards gradually increases throughout the remainder of the strobila. The segments are broader than long, the largest measuring 80µ in length by 650µ in width.

The genital pores are unilateral. In each segment the pore is located near the middle of the right-hand margin.

Internal anatomy.

Nervous system.—The lateral longitudinal nerves (fig. 34, *l. n.*) are about midway between the lateral borders of the segment and the excretory vessels.

Musculature.—The longitudinal muscles are arranged in two layers. The outer layer (fig. 34, *ext. musc.*) is composed of numerous small bundles of fibers close to the surface of the segment. The inner layer (fig. 34, *int. musc.*) consists of eight bundles, as a rule somewhat larger than the outer bundles, and conspicuous only in young segments.

Transverse muscle fibers are well developed only at the junction of the segments. The dorso-ventral fibers are very weakly developed.

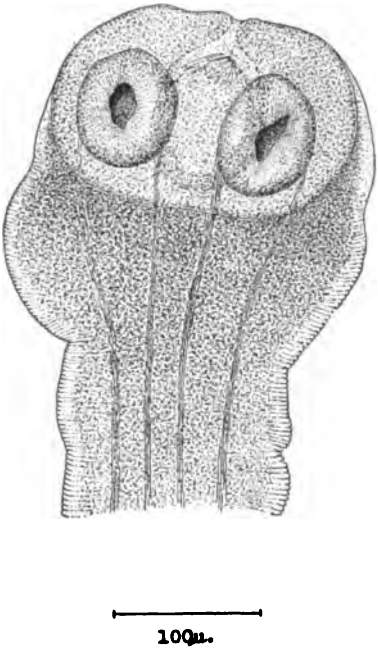

FIG. 31.—DIORCHIS ACUMINATA: HEAD WITH RETRACTED ROSTELLUM.

Excretory system.—The longitudinal excretory vessels (figs. 34, *v. ex.*, *d. ex.*; 35, *v. ex.*) in the older segments are located near the ventral surface on the right-hand (pore) side of the segment and near the dorsal surface on the left-hand side. The dorsal vessel is close to and dorsal of the ventral vessel. The ventral vessels are not connected by transverse vessels.

The cirrus pouch and vagina pass dorsal of the nerve and excretory vessels.

Male reproductive organs.—The testicles (fig. 33, *t.*) are two in number, located near the dorsal surface in the posterior portion of the segment, one on either side of the median line, and reach a maximum size of 100 to 130μ. A portion of the vas deferens is swollen to form a seminal vesicle (figs. 33, 34, *ves. sem.*), which attains a size of 80 to 130μ in diameter. This seminal vesicle is located in the median line close to the anterior border of the segment near the dorsal surface.

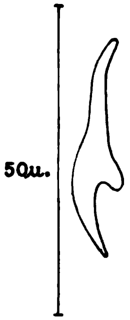

FIG. 32.—DIORCHIS ACUMINATA: HOOK FROM ROSTELLUM.

The cirrus pouch (figs. 33, 34, *c. p.*) is elongated, extending transversely across the segment. As a rule its inner end does not reach the median line. It measures 180 to 280μ in length, and 45 to 55μ in maximum thickness. It is covered with a layer of longitudinal muscles, thickest near the middle and diminishing in thickness toward each end of the pouch. Within the cirrus pouch the vas deferens is swollen to form a seminal reservoir occupying more or less of the cavity of the pouch, according to the quantity of spermatozoa contained. The cirrus (figs. 33, 35, *cir.*) is unarmed; when extruded it measures 6 to 8μ in diameter, with a globular swelling at its base 14 to 16μ in diameter. When fully extruded it measures over 150μ in length.

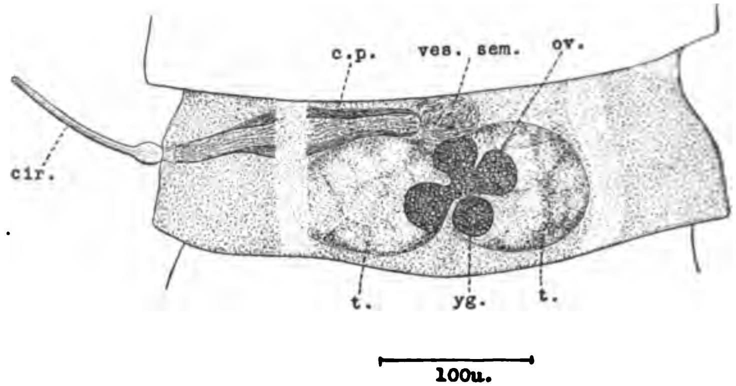

FIG. 33.—DIORCHIS ACUMINATA: SEXUALLY MATURE SEGMENT. *cir.*, CIRRUS. *c. p.*, CIRRUS POUCH. *ov.*, OVARY. *t.*, TESTICLES. *ves. sem.*, SEMINAL VESICLE. *yg.*, YOLK GLAND.

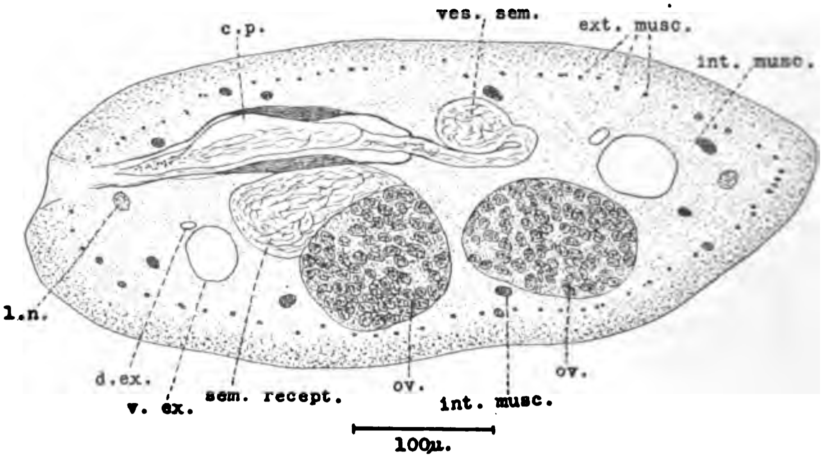

FIG. 34.—DIORCHIS ACUMINATA: SEXUALLY MATURE SEGMENT, TRANSVERSE SECTION. *c. p.*, CIRRUS POUCH. *d. ex.*, DORSAL EXCRETORY VESSEL. *ext. musc.*, OUTER LONGITUDINAL MUSCLES. *int. musc.*, INNER LONGITUDINAL MUSCLES. *l. n.*, NERVE CORD. *ov.*, OVARY. *sem. recept.*, SEMINAL RECEPTACLE. *v. ex.*, VENTRAL EXCRETORY VESSEL. *ves. sem.*, SEMINAL VESICLE.

Female reproductive organs.—The vagina, after crossing the excretory canals, is enlarged to form a seminal receptacle (figs. 34, 36, *sem. recept.*), which extends inward as far as the inner end of the cirrus pouch.

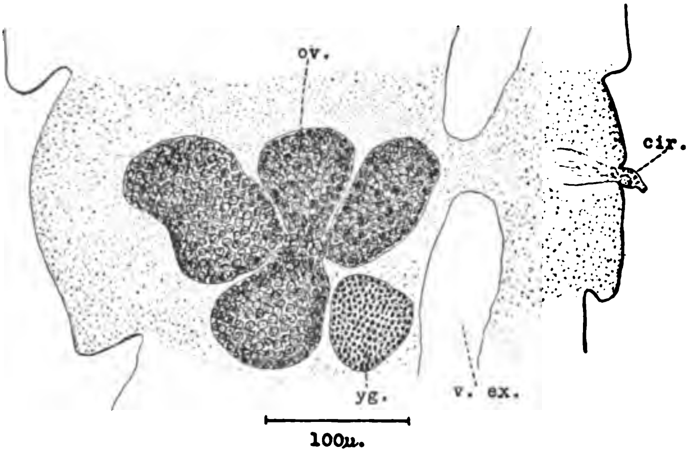

FIG. 35.—DIORCHIS ACUMINATA: SEXUALLY MATURE SEGMENT. HORIZONTAL SECTION. *cir.*, CIRRUS. *ov.*, OVARY. *v. ex.*, VENTRAL EXCRETORY VESSEL. *yg.*, YOLK GLAND.

The ovary (figs. 33–36, *ov.*) is trilobed, one lobe being anterior and median, the other two lateral; often by a division of the left lateral lobe it becomes four-lobed. When fully developed the ovary extends laterally as far as the excretory canals, and the median lobe extends forward to the anterior border of the segment. It is ventral with respect to the testicles.

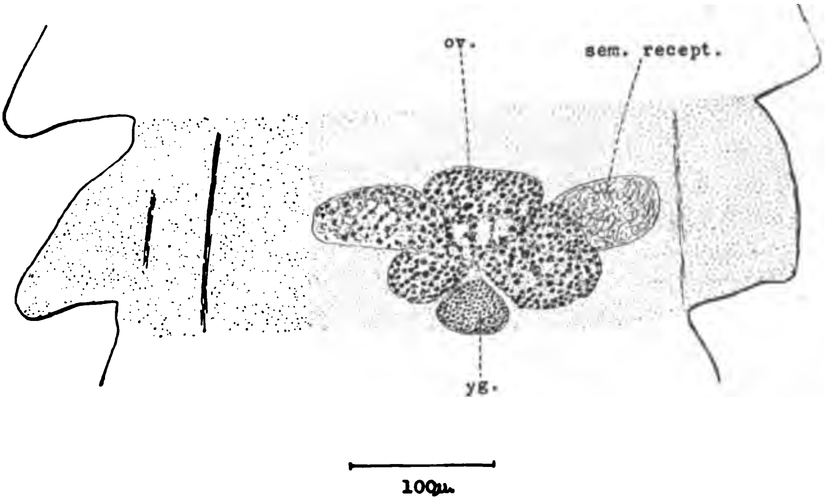

FIG. 36.—DIORCHIS ACUMINATA: SEXUALLY MATURE SEGMENT, HORIZONTAL SECTION. *ov.*, OVARY. *sem. recept.*, SEMINAL RECEPTACLE. *yg.*, YOLK GLAND.

The yolk gland (figs. 33, 35, 36, *yg.*) is spherical, 45 to 60μ in diameter, located in the median line near the ventral surface of the segment, behind the middle of the ovary, in the niche between the right and left lateral lobes.

The uterus was not yet developed in the specimens studied.

Remarks.

In certain respects the tapeworm described above is strikingly similar to a form from *Fulica atra* described by Jacobi (1898c, pp. 95–104, pl. 6, figs. 1–16) as *Tænia inflata* Rudolphi.

The chief characters of this form, summarized from Jacobi's description, are as follows:

Length 80 to 100 mm., width 2 to 3 mm. Head with a prominent rostellum [similar in shape to that of *Diorchis acuminata*], armed with a crown of 10 hooks, 23μ long [similar in form to those of *Diorchis acuminata*]. Segments broader than long throughout the strobila. Genital pores unilateral. Longitudinal muscles arranged in two layers of bundles, an outer layer of numerous small bundles close to the surface of the body, and an inner layer of 8 larger bundles [as in *Diorchis acuminata*]. The cirrus pouch and vagina pass on the dorsal side of the longitudinal nerve and excretory vessels. Testicles two. Seminal vesicle absent; vas deferens enlarged within the cirrus pouch to form a seminal reservoir. Cirrus pouch with an outer layer of longitudinal muscles [as in *Diorchis acuminata*]. Size of cirrus pouch[a] not exactly stated, but it does not extend as far as the median line. Cirrus unarmed; when extruded has a bulbous enlargement at the base [as in *Diorchis acuminata*], and, to judge from the scale of magnification to which Jacobi's figures are drawn, measures from 6 to 8μ in diameter, the bulbous enlargement being 12 to 14μ in diameter. Vagina enlarged to form a seminal receptacle. Ovary trilobed; shell gland spherical, ventral of and posterior of the ovary. The ovary, when fully mature, is about one-fourth as wide as the segment. The uterus is a simple sac, which develops on the dorsal side of the ovary and ventral of the testicles. Eggs with two thin shells in addition to a membrane, which closely invests the oncosphere. The shells are drawn out into pointed processes at the poles. Oncosphere 17μ in maximum diameter, outer shell 37 to 41μ in length, hooks of oncosphere 9.2μ long.

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[a] Clerc (1903) describes and figures the cirrus pouch in a form from *Fulica atra* which he has identified with Jacobi's species, as very long and extending far beyond the median line. Jacobi, although remarking that the cirrus pouch is very long, distinctly states that it extends *almost* to the median line, and it is thus shown in his figures. Whether such a wide variation in the size of cirrus pouch may occur, or whether Clerc had before him some other species, are questions which can not be definitely determined until further evidence is available.

In general structure the form from *Fulica americana* and Jacobi's species are alike, and the cirrus pouch and cirrus in size and shape are practically the same in both. Comparing, however, the length of the hooks of Jacobi's species, 23μ, with that of the hooks of the form which I have described, 38μ, and taking into consideration the lack of a seminal vesicle in the former, its presence in the latter, the small size of the fully developed ovary in the former, and the very large size of the ovary in the latter, it seems necessary to look upon these forms as two different species.

Diorchis acuminata, collected from *Anas crecca*, *A. strepera*, and *Fulica atra*, as described by Clerc (1903, pp. 281–284, pl. 8, fig. 13; pl. 9, fig. 25; pl. 11, figs. 78, 88), measures about 80 mm. in length and 1.2 mm. in maximum breadth. The width of the head varies from 230 to 320μ. The rostellum is armed with 10 hooks 27 to 39μ in length. The segments are broader than long throughout the strobila, the usual ratio being 14 to 1. Fully developed eggs are present in segments 50 to 60 mm. from the scolex, and the female genital glands are well developed in segments 25 mm. from the scolex. The genital pores are unilateral. The excretory vessels are without commissures in the posterior part of the segment. The longitudinal muscles are arranged in two layers, numerous small bundles in the outer layer, and 8 larger bundles in the inner layer. The vagina and cirrus pouch pass dorsal of the excretory vessels and nerve. There are two testicles present in each segment, reaching their maximum development in segments 15 to 17 mm. from the head. The cirrus pouch measures at its maximum of development 150 to 160μ in length, is straight or slightly curved, shaped like a thick spindle, and does not reach the median line of the segment. Its musculature consists especially of longitudinal fibers. The female glands occupy very little space, never exceeding in size one-third of the width of the segment. They are located exactly in the middle of the segment beneath the testicles. The ovary is "double, non lobé, en forme d'haltère recourbé dont les extrémités épaissies sont tournées vers la face dorsale." The yolk gland is globular, small, and located between the two wings of the ovary. The vagina is ventral of the cirrus pouch. Its initial portion is muscular, the remainder is swollen, possesses thin walls and acts as a seminal receptacle. The uterus is sac-like. At the beginning of its development it is like a narrow transverse canal. It develops large lobes which penetrate between the longitudinal muscles and beyond the excretory vessels. The eggs are elongated in form.

The only differences between the form from *Fulica americana* and Clerc's species, so far as may be determined from Clerc's description, are in the length of the cirrus pouch (which is slightly greater in the specimens from *Fulica americana*) and in the shape and size of the ovary. Although Clerc makes no reference to the presence of spines on the suckers, this is a feature which is very inconspicuous and may have been overlooked by that author.[a]

The differences mentioned seem to be insufficient to warrant a separation of the two forms, and the identification of the tapeworms from *Fulica americana* as *Diorchis acuminata*, accordingly, seems fully justifiable. Fuhrmann (1908a, pp. 7, 81), however considers it improbable that the same species should occur in birds so different as Anserines and Ralliforms, and explains Clerc's record of *Diorchis acuminata* in *Fulica* as due to some error, possibly a mistake in labeling. A comparison of specimens is needed to settle the question whether the forms from ducks and *Fulica* are of the same or different species.

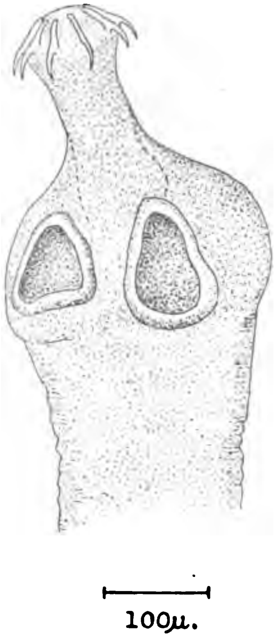

FIG. 37.—DIORCHIS AMERICANA: HEAD.

DIORCHIS AMERICANA, new species.

Figs. 37–42.

This species, which seems heretofore to have been undescribed, was found in company with *Diorchis acuminata* in *Fulica americana*, and is based on specimens (from the collection of H. B. Ward, deposited in the U. S. National Museum Helminthological Collection, No. 7238), collected in Nebraska.

External anatomy.

The length of specimens whose posterior segments were gravid, but in which the eggs had evidently not yet reached their full development, was from 20 to 25 mm. and the maximum width 0.6 mm. The head (fig. 37) measures 160µ in length by 250µ in width. The rostellum is similar in shape to that of *Diorchis acuminata* but larger, measuring when fully extended 135µ in length, by 50µ in diameter at the base and 80µ in diameter at the tip, armed with a crown of 10 hooks (fig. 38) 65µ long, similar in form to those of *Diorchis acuminata*.

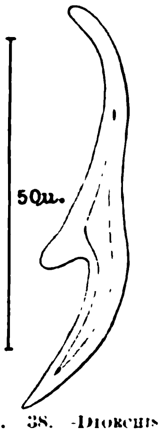

FIG. 38.—DIORCHIS AMERICANA: HOOK FROM ROSTELLUM.

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[a] Since publishing his description of *Diorchis acuminata* Clerc has informed Fuhrmann (1906b, p. 620) that he has observed that the suckers may be armed.

The dorsal root measures about 40μ and the prong of the hook about 25μ in length. The suckers are 100 to 120μ in diameter, covered over the entire surface as in *D. acuminata* with regularly arranged minute spines less than 5μ in length.

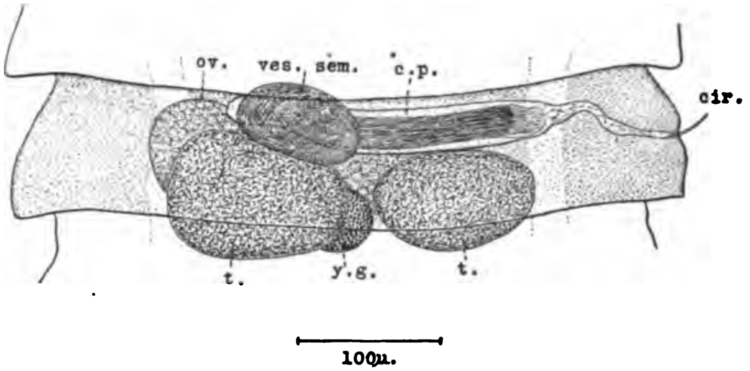

Fig. 39.—Diorchis americana: Sexually mature segment, at high focus to show male organs, dorsal view. *cir.*, Cirrus. *c. p.*, Cirrus pouch. *ov.*, Ovary. *t.*, Testicles. *ves. sem.*, Seminal vesicle. *y. g.*, Yolk gland.

As in *D. acuminata*, segmentation begins close behind the head, the width of the strobila at its beginning being about 160μ. The segments are broader than long throughout the strobila, and near the posterior end measure 110 to 115μ in length by 500 to 600μ in width.

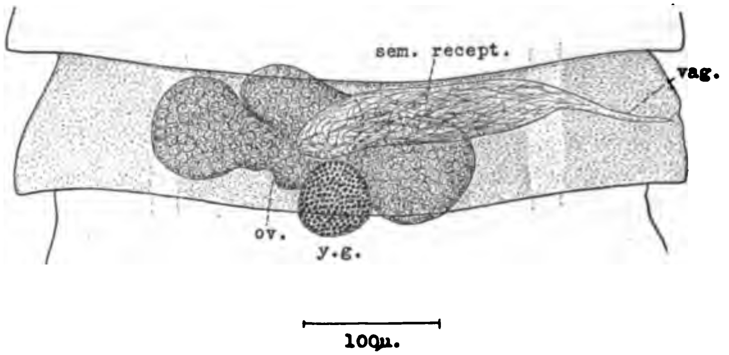

Fig. 40.—Diorchis americana: Sexually mature segment, at deep focus to show female organs, dorsal view. *ov.*, Ovary. *sem. recept.*, Seminal vesicle. *vag.*, Vagina. *y. g.*, Yolk gland.

The genital pores are unilateral on the right-hand margin of the strobila at about the middle of the segment.

Internal anatomy.

The nervous system, musculature, and excretory system are as described above for *Diorchis acuminata*, and as in the latter the vagina and cirrus pouch pass on the dorsal side of the nerve and excretory vessels.

In this species the segments become gravid much earlier than in the other, as the posterior segments of a strobila 20 mm. long contained a well-developed uterus, whereas in *Diorchis acuminata* the uterus had not yet appeared in the posterior segments of a strobila 35 mm. long.

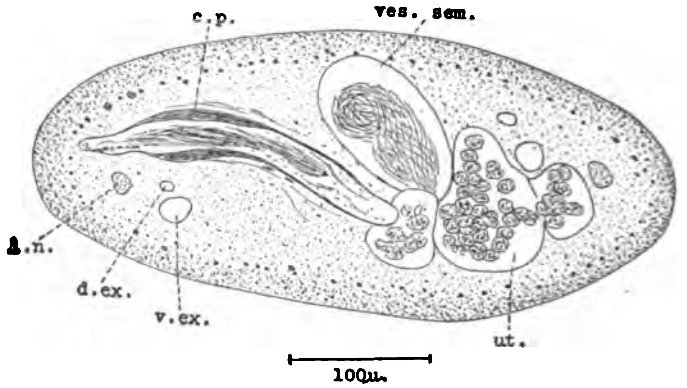

FIG. 41.—DIORCHIS AMERICANA: GRAVID SEGMENT, TRANSVERSE SECTION. *c. p.*, CIRRUS POUCH. *d. ex.*, DORSAL EXCRETORY VESSEL. *l. n.*, NERVE CORD. *ut.*, UTERUS. *ves. sem.*, SEMINAL VESICLE. *v. ex.*, VENTRAL EXCRETORY VESSEL.

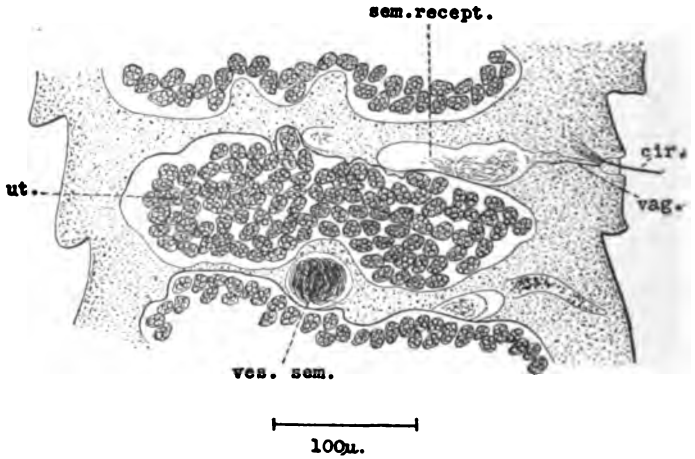

FIG. 42.—DIORCHIS AMERICANA: GRAVID SEGMENTS, HORIZONTAL SECTION. *cir.*, CIRRUS. *sem. recept.*, SEMINAL RECEPTACLE. *ut.*, UTERUS. *vag.*, VAGINA. *ves. sem.*, SEMINAL VESICLE.

Male reproductive organs.—The testicles (fig. 39, *t.*), two in number, attaining a maximum size of 100 to 130μ, are located, as in *D. acuminata*, in the posterior portion of the segment near the dorsal surface, one on either side of the median line.

In the anterior half of the segment in the median line the vas deferens is swollen to form a prominent seminal vesicle (figs. 39, 41, *ves. sem.*), 150μ or more in diameter. Usually the seminal vesicle is dorsal of, occasionally ventral of, the proximal end of the cirrus pouch. The cirrus pouch (figs. 39, 41, *c. p.*), usually somewhat curved, extends transversely across the anterior portion of the segment, measuring 250 to 300μ in length by 30 to 40μ in thickness. It is somewhat longer than the cirrus pouch of *D. acuminata* and usually extends beyond the median line of the segment. As in the latter species, the pouch is covered with a prominent layer of longitudinal muscles, thickest near the middle of the pouch. The vas deferens is enlarged to form a seminal reservoir within the cirrus pouch. In sharp contrast to *D. acuminata*, the cirrus (fig. 39, *cir.*) is very slender without bulbous enlargement at the base, measuring but 1.5 to 2μ in diameter when extruded, whereas in the other species it is from 6 to 8μ in diameter, and has a bulbous enlargement at the base 14 to 16μ in diameter. As in the latter species, it is unarmed. Its length when fully extruded is at least 100μ.

Female reproductive organs.—The vagina (figs. 40, 42, *vag.*), at first very narrow, becomes swollen beyond the excretory canals to form an elongated seminal receptacle (figs. 40, 42, *sem. recept.*), which lies against the ventral side of the cirrus pouch and extends as far as the inner end of the latter.

The ovary (figs. 39, 40, *ov.*), as in *D. acuminata*, is trilobed with occasionally a fourth lobe on the left-hand side, and when fully developed it extends laterally as far as the excretory canals, and its median lobe reaches the anterior border of the segment. It is located on the ventral side of the cirrus pouch, seminal vesicle, and seminal receptacle. The yolk gland (figs. 39, 40, *y. g.*) is similar in shape and size to that of *D. acuminata* and is similarly located.

The uterus (figs. 41, 42, *ut.*) is a simple sac, without partitions, and develops behind and dorsal of the ovary and ventral of the testicles. As the uterus increases in size and becomes filled with eggs the ovary degenerates and disappears. When fully developed the uterus extends from the posterior to the anterior border of the segment, and laterally beyond the excretory canals on each side, dorsal of the canals on the right side and ventral of the canals on the left side.

The eggs when they first enter the uterus measure 12 to 15μ in diameter and are closely surrounded by a very thin membrane. Eggs containing fully formed oncospheres were not present in the specimens studied.

SYNOPSIS OF THE SUPERFAMILY TÆNIOIDEA.

In the following synopsis I have adopted with a few modifications the arrangement into families recently proposed by Fuhrmann (1907a, 1908a), but instead of giving the group the rank of an order, Cyclophyllidea, I have followed Stiles (1906a) in classing it as a superfamily, Tænioidea. This change from order to superfamily is simply a change in name and rank and in itself does not necessitate any changes within the group. The subordinate groups of the order Cyclophyllidea as arranged by Fuhrmann can be arranged in a similar way in the superfamily Tænioidea, and this is what has been done in the present article, with, however, a number of modifications, the most important of which are as follows:

In his family "Dilepinidæ" Fuhrmann has recognized three subfamilies, "Dilepininæ," Dipylidiinæ, and "Paruterinæ," and has placed in a separate family, "Hymenolepidæ," the genera *Hymenolepis*, *Oligorchis*, *Diorchis*, and *Aploparaksis*. I have, however, preferred to unite "Hymenolepidæ" with "Dilepinidæ" and "Dilepininæ" with Dipylidiinæ, and accordingly recognize, instead of the two families, one family Hymenolepididæ, with Dipylidiinæ, Hymenolepidinæ, and Paruterininæ (= Paruterinæ Fuhrmann) as subfamilies.

The genus *Stilesia* appears to me much more closely related to the Paruterininæ than to the Anoplocephalidæ, and I have accordingly placed it in the former group.

A number of minor changes, such as changes in names, are noted in their appropriate places. Changes in names have been made in accordance with the International Code of Zoological Nomenclature.

Superfamily TÆNIOIDEA.

Superfamily diagnosis.—Cestoda: Scolex with four cup-shaped suckers which may exceptionally (Tetrabothriidæ) bear auricular appendages. Apical rostellum present or lacking. Suckers and rostellum may be armed with hooks or unarmed. Neck present or absent. Strobila with well-developed segmentation, or, exceptionally (Fimbriariidæ) without division into segments. A single series or complete or incomplete double series of reproductive organs. Genital pores usually present and marginal, or exceptionally on ventral surface. Testicles usually numerous, in medullary portion of segment. Ovary more or less bilobed. Yolk gland compact, and posterior, dorsal, ventral, or laterad of ovary, rarely (family Tetrabothriidæ) anterior of ovary. Shell gland between ovary and yolk gland. Uterus without special opening to the exterior, except that rarely a secondarily formed opening may be present. Egg (i. e., fertilized egg=

embryo, oncosphere) with one or several membranes; without operculum. Larval stage in vertebrates or invertebrates. Adults in alimentary canal of vertebrates.

Type-family.—Tæniidæ Ludwig, 1886.

KEY TO GENERA.[a]

1. Genital pores marginal or (?) absent ---- 2.

Genital pores ventral, in or near median line; scolex unarmed, without rostellum; a single egg capsule in the gravid segment. Mesocestoididæ, *Mesocestoides*, p. 61.

2. One cirrus pouch in each segment, or two in each segment, one on either side ---- 3.

Several cirrus pouches in each lateral half of each segment; segmentation not apparent externally; one testicle, ovary, yolk gland, and uterus in each lateral half of the segment; egg with well-developed pyriform apparatus; head unarmed, without rostellum; adults in marsupials. *Triplotænia*, p. 62.

3. Vaginal pore anterior of male opening ---- *Tetracisdicotyla*, p. 106.

Vaginal pore posterior, dorsal, or ventral of male opening, or absent ---- 4.

4. Anterior portion of strobila enlarged and modified to form a large pseudo scolex; strobila grooved transversely, but without proglottids. Fimbriariidæ, *Fimbriaria*, p. 105.

Strobila without pseudo scolex; with more or less definite proglottids, or segments ---- 5.

5. Yolk gland in front of ovary; suckers with auricular appendages on anterior border ---- Tetrabothriidæ, *Tetrabothrius*, p. 59.

Yolk gland posterior, dorsal, ventral, or lateral of ovary; suckers without auricular appendages ---- 6.

6. Vaginal pore lacking ---- 7.

Vaginal pore present ---- 15.

7. Male and female genital openings both (?) lacking; scolex without rostellum; suckers unarmed; a single set of reproductive organs in each segment; female glands near one side of the segment; cirrus pouch rudimentary, unites with distal end of vagina in lateral field of segment ---- *Aporina*, p. 64.

Male genital opening present ---- 8.

8. Scolex with armed rostellum; segments with lateral appendages; accessory female genital canal present, functioning as vagina, with dorsal, ventral, or marginal opening ---- 9 (Amabiliidæ).

Scolex with or without rostellum; segments without lateral appendages; vagina, without external opening, functions as seminal receptacle. 11 (Acoleidæ).

9. A double set of male reproductive organs and a single set of female organs in each segment; two male genital pores in each segment, one on each side; opening of accessory vagina ventral ---- *Amabilia*, p. 103.

A single set of reproductive organs in each segment; male genital pores regularly or irregularly alternate ---- 10.

10. Suckers and posterior portion of head covered with minute spines; segments of strobila not numerous; testicles few; vagina of each segment turns backward into and communicates with the seminal vesicle of the next

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[a] The genus *Copesoma* (p. 106) is not included in this key.

following segment; an accessory vagina in the opposite side of the segment from the cirrus pouch, sometimes with marginal opening---*Tatria*, p. 104.

Rostellum very large; suckers and posterior portion of head without spiny armature; testicles numerous, extend across entire width of segment; vagina absent; accessory vagina dorso-ventral, with median opening on dorsal and ventral surfaces of segment--------------*Schistotænia*, p. 104

11. Diœcius, entire strobila male or female; male with a double set, female with a single set of reproductive organs in each segment---*Dioicocestus*, p. 103.

Monœcius-- 12.

12. A single set of reproductive organs in each segment------------------- 13.

A double set of male reproductive organs and a single set of female reproductive organs in each segment, with two vaginæ functioning as large seminal receptacles--------------------------------*Diplophallus*, p. 102.

13. Scolex with armed rostellum------------------------------------- 14.

Scolex without rostellum, but with apical papilla; cirrus conical in shape, armed with large hooks-------------------------------*Shipleya*, p. 103.

14. Rostellum armed with a single crown of hooks arranged in a zigzag row having right angles; testicles few; seminal receptacle very small; uterus with dorsal and ventral openings--------------------*Gyrocœlia*, p. 102.

Testicles numerous; seminal receptacle very large; uterus without opening to the exterior--*Acoleus*, p. 102.

15. Scolex with rostellum armed with a double row (rarely a single or triple row) of very numerous (and generally very small) hammer-shaped hooks, i. e., with long ventral root, very short dorsal root, and short blade; suckers usually armed ------------------------------ 16 (Davaineidæ).

Scolex with rostellum armed with hooks not hammer shaped, without rostellum, or with rudimentary unarmed rostellum; suckers usually armed- 21.

16. Rostellum broader than rest of scolex; suckers armed only near anterior border; a single set of reproductive organs in each segment; uterus saclike, persistent-------------------------------------*Ophryocotyle*, p. 67.

Rostellum not broader than rest of scolex; suckers armed with several rings of hooklets around the periphery or unarmed; a single or double set of reproductive organs in each segment; uterus not persistent, replaced by egg capsules, with or without the formation of para-uterine organs-- 17.

17. Uterus breaks down into numerous egg capsules, each containing one or more eggs; para-uterine organs not present----------------------- 18.

A para-uterine organ present, into which the eggs pass, and which transforms into an egg capsule-------------------------------------- 20.

18. A single set of reproductive organs in each segment------------------- 19.

A double set of reproductive organs in each segment; eggs become inclosed singly in egg capsules----------------------------------*Cotugnia*, p. 69

19. Rostellum armed with a double or single row of hooks; dorsal excretory vessels present; genital pores unilateral or irregularly alternate; egg capsules contain one or several eggs--------------------*Davainea*, p. 67.

Rostellum armed with three rows of hooks; dorsal excretory vessels absent; genital pores unilateral; female glands on pore side of median line, near the ventral excretory vessel; eggs become inclosed singly in egg capsules--------------------------------------*Porogynia*, p. 69.

20. Eggs pass directly from uterus into a para-uterine organ, which transforms into an egg capsule-----------------------------*Idiogenes*, p. 70.

Eggs become inclosed in numerous egg capsules following the disappearance of the uterus, and finally are pressed into a large anteriorly located para-uterine organ which transforms into an egg capsule-*Chapmania*, p. 70.

21. Scolex without rostellum, or with rudimentary unarmed rostellum------ 49.

Scolex with armed rostellum------ 22.

22. Rostellum armed with a double crown of large hooks; genital pores irregularly alternate; uterus with median stem and lateral branches; egg with thin outer membrane and thick, brown, radially striated inner shell. *Tænia*, p. 100.

Egg with thin transparent shells------ 23.

23. Para-uterine organ present; rostellum armed with a double crown of hooks------ 24.

Para-uterine organ absent------ 26.

24. Uterus single------ 25.

Uterus more or less completely divided into two spherical sacs; hooks of rostellum triangular------ *Biuterina*, p. 88.

25. Uterus much broader than long; para-uterine organ a transversely elongated parenchymatous mass in front of uterus; on pore side of segment the large usually ventral longitudinal excretory vessel is dorsal in position, and the narrow usually dorsal vessel ventral, the position being normal on other side------ *Culcitella*, p. 86.

Uterus slightly broader than long, crescentic, in front of ovary, or straight, near posterior border of segment; para-uterine organ elongated anteroposteriorly in front of uterus; position of excretory vessels normal on both sides of segment------ *Paruterina*, p. 85

26. Rostellum armed with a single or double row of hooks; suckers armed or unarmed------ 27.

Rostellum armed with several rings of rose-thorn hooklets; a double set of reproductive organs in each segment; two genital pores in each segment, one on each side; uterus reticular, later breaking up into egg capsules. *Dipylidium*, p. 84.

27. A single set of reproductive organs in each segment------ 28.

A double set of male reproductive organs and a single set of female organs with two vaginæ in each segment; two genital pores in each segment, one on each side; uterus sac-like, persistent------ *Diploposthe*, p. 101.

28. Uterus persistent------ 29.

Uterus breaks down into egg capsules, each containing one or several eggs; rostellum armed with a double or single crown of hooks; genital pores irregularly alternate, rarely unilateral; testicles numerous, behind the female glands or also laterally on both sides of the latter. *Monopylidium*, p. 76.

29. Hooks of rostellum arranged in a circular crown------ 30.

Hooks of rostellum arranged in a zigzag crown; genital canals pass dorsal of excretory vessels; uterus very irregularly lobulated------ *Angularia*, p. 83.

30. Crown of hooks single------ 31.

Crown of hooks double------ 41.

31. Genital pores unilateral------ 32.

Genital pores alternate------ 34.

32. Genital pores subdorsal; testicles few, but more than 4 in each segment; eggs few------ *Trichocephaloides*, p. 73.

Genital pores strictly marginal; testicles numerous or few; eggs numerous, or, rarely, few------ 33.

33. Base of cirrus provided with one or two pairs of powerful spines lying in special pockets; genital canals pass between longitudinal excretory vessels------ *Gryporhynchus*, p. 83.

Base of cirrus not provided with spines in special pockets; genital canals pass dorsal of excretory vessels........ 36.

34. Segments numerous, rarely less than 30; neck present; genital pores irregularly alternate near anterior border of segment; testicles numerous, posterior of female glands or also laterally on both sides of the latter; uterus a simple sac, or incompletely divided into numerous small communicating compartments........ *Choanotænia*, p. 74

Segments less than 30 in number; neck absent; genital pores regularly alternate........ 35.

35. Testicles in posterior portion of segment; cirrus pouch short. *Amœbotænia*, p. 80.

Testicles lateral in position toward the pore side of the segment; cirrus pouch very long........ *Leptotænia*, p. 81.

36. Testicles, 12 or more in each segment........ *Lateriporus*, p. 73.

Testicles, 1 to 4 in each segment........ 37 (Hymenolepidinæ).

37. Testicles, 4 in each segment........ *Oligorchis*, p. 89.

Testicles, 1 to 3 in each segment........ 38.

38. Testicles, 3 in each segment........ 39 (*Hymenolepis*).

Testicles, 1 or 2 in each segment........ 40.

39. Entire surface of suckers armed with minute spines, or (generally) unarmed; sacculus accessorius usually absent........ *Hymenolepis* s. str., p. 90.

Suckers armed on borders and in the middle with small hooklets; sacculus accessorius always present........ *Echinocotyle*, p. 98.

40. Testicles, 2 in each segment; entire surface of suckers armed with minute spines, or unarmed; rostellar hooks with long dorsal and short ventral roots (or exceptionally with very short dorsal root, and with ventral root nearly as long as the blade)........ *Diorchis*, p. 98.

One testicle in each segment; suckers (?) unarmed; rostellar hooks with ventral root as long or nearly as long as the blade; strobila small and slender........ *Aploparaksis*, p. 99.

41. Genital pores unilateral........ 42.

Genital pores alternate........ 45.

42. Root of cirrus with one or two pairs of powerful spines lying in special pockets; testicles few; genital canals pass between the longitudinal excretory vessels........ *Gryporhynchus*, p. 83.

Spiniferous sacs at base of cirrus lacking........ 43.

43. No testicles in front of female glands, but usually very numerous behind and at the sides; rostellar hooks with long dorsal and short ventral roots; genital canals pass dorsal of excretory vessels and nerve........ *Dilepis*, p. 71.

Testicles entirely surrounding the female glands, or limited to the region in front of the female glands........ 44.

44. Testicles very numerous, entirely surrounding the female glands; cirrus pouch communicating with the genital cloaca by a narrow canal opening upon a large papilla; rostellar hooks with a very large dorsal root and small hook portion........ *Cyclorchida*, p. 82.

Testicles limited to the region in front of female glands........ *Proorchida*, p. 82.

45. Testicles scattered throughout entire dorsal portion of medullary parenchyma; ovary and yolk gland surrounded by a ring-like uterus with secondary branches; genital canals pass between excretory vessels; longitudinal musculature in three layers........ *Cyclustera*, p. 81.

Testicles, in lateral or posterior portions of segment only........ 46.

46. Testicles in lateral portions of segment only........ 47.

Testicles in posterior portion of segment only........ 48.

47. Division of strobila into segments well marked; female glands toward pore side of segment; genital canals pass between the excretory vessels and ventral of the nerve; genital pores irregularly alternate.
Laterotænia, p. 82.

Strobila small, division into segments not well marked; scolex large with small rostellum; reproductive glands very small; ovary and yolk gland toward pore side of segment; genital pores irregularly alternate.
Parvirostrum, p. 81.

48. Genital canals pass between the longitudinal excretory vessels and dorsal of the nerve; genital pores irregularly alternate; strobila usually with numerous segments; uterus sac-like________________*Anomotænia*, p. 77.

Genital canals pass dorsal of the longitudinal vessels and nerve; strobila with few segments (less than 30); genital pores regularly alternate; uterus much lobulated; outer shell of egg with tubular prolongation at each pole terminating in a globular expansion______________*Liga*, p. 80.

49. A single genital pore in each segment______________________________ 50.

Two genital pores in each segment, one on each side________________ 67.

50. Para-uterine organs absent_______________________________________ 51.

Para-uterine organs present______________________________________ 62.

51. Uterus persistent____ 52.

Uterus not persistent, breaks down into numerous egg capsules, each containing one or more eggs____ 60.

52. Three testicles in each segment; rostellum present but rudimentary and unarmed___________________________________*Hymenolepis* s. str., p. 90.

Testicles more than three in each segment_________________________ 53.

53. Uterus with median stem and lateral branches; rostellum rudimentary and unarmed, or lacking____ 54.

Uterus sac-like or reticular, without median stem; rostellum lacking___ 55.

54. Female glands in posterior median portion of segment; testicles scattered throughout the medullary parenchyma except the posterior median portion; egg with a thin outer membrane, and thick brown radially striated inner shell; rostellum present but unarmed and rudimentary_*Tænia*, p. 100.

Female glands in anterior portion of segment; testicles in posterior portion; egg with thin transparent shells; rostellum absent____*Catenotænia*, p. 84.

55. A distinct pedunculated prostatic gland near ventral excretory vessel on pore side of median line; egg with pyriform apparatus, the horns of which are rather short; adults in mammals______________*Andrya*, p. 63.

Pedunculated prostatic gland absent________________________________ 56.

56. Eggs with pyriform apparatus____________________________________ 57.

Eggs without pyriform apparatus__________________________________ 59.

57. Uterus a transversely elongated sac with outpocketings anteriorly and posteriorly ____ 58.

Extreme lateral portions of uterus sac-like, remainder a complicated system of irregular lacunæ; testicles near the posterior border of segment extending from the excretory vessels of one side to those of the other; adults in mammals______________________________*Schizotænia*, p. 64.

58. Testicles in anterior portion of segment extending entirely across the median field as far as the excretory vessels; adults in birds and mammals.
Bertiella, p. 62.

Testicles in median field toward side of segment opposite genital pore; female glands in median field toward pore side; adults in mammals.
Anoplocephala, p. 62.

59. Testicles in anterior portion of segment extending entirely across the median field as far as the excretory vessels; uterus a transversely elongated sac with numerous outpocketings anteriorly and posteriorly; adults in birds and mammals---- *Bertiella*, p. 62.

Testicles mostly in the lateral portions of the segment on both sides of the longitudinal excretory vessels, extending from the anterior to the posterior border of the segment; uterus median, bilobed, with a prolongation posteriorly on each side which crosses the longitudinal excretory vessels, and passes forward laterad of and parallel with the latter; adults in birds---- *Aporina*, p. 64.

60. Cortical layer of parenchyma thin; testicles behind and at sides of female glands; adults in mammals and reptiles---- *Oochoristica*, p. 84.

Cortical layer of parenchyma very thick; testicles dorsal, scattered throughout the entire length of the segment---- 61.

61. Genital pores unilateral; genital canals pass between excretory vessels; female glands between dorsal and excretory vessels on pore side of segment; adults in birds---- *Zschokkeella*, p. 65.

Genital pores alternate; genital canals pass ventral of the excretory vessels; female glands submedian, only slightly displaced toward pore side of segment; adults in monotremes and marsupials---- *Linstowia*, p. 65.

62. One testicle in each segment; strobila circular in cross section with segmentation distinct only at posterior end; adults in amphibia.
Nematotænia, p. 88.

More than one testicle in each segment---- 63.

63. Uterus transversely elongated, composed of numerous ascon-like pouches, each supplied with a para-uterine organ; adults in mammals.
Thysanosoma, p. 66.

A single and simple or bilobed uterus with a single para-uterine organ in each segment, or two uteri, each with a para-uterine organ---- 64.

64. Two uteri in each segment, small, spherical, sac-like, one in each lateral half between the dorsal and ventral excretory vessels; testicles relatively few, in two sets, one in each side of the segment in the neighborhood of the excretory vessels; ovary small, globose, between the excretory vessels on pore side of the segment; adults in mammals---- *Stilesia*, p. 89.

Uterus single and simple or bilobed; adults in birds---- 65.

65. Testicles dorsal of female glands and toward anterior border of segment; genital canals pass ventral of excretory vessels; uterus simple, sac-like, commonly displaced toward side of segment opposite genital pore.
Anonchotænia, p. 86.

Testicles in posterior portion of segment, behind the female glands, may also extend forward along sides of latter; genital canals pass between excretory vessels---- 66.

66. Uterus tubular and elongated longitudinally, or globular, occupying the median line of the segment---- *Rhabdometra*, p. 86.

Uterus when fully developed consisting of two spherical sacs touching in the median line and more or less fused---- *Metroliasthes*, p. 87.

67. Para-uterine organs present---- 68.

Para-uterine organs absent---- 69.

68. Uterus single, transversely elongated, undulating, composed of numerous ascon-like pouches, each supplied with a para-uterine organ; adults in mammals---- *Thysanosoma*, p. 66.

Two small, spherical uteri in each segment, one on either side, between the dorsal and ventral excretory vessels, each with a single para-uterine organ; adults in mammals---- *Stilesia*, p. 89.

69. **Uterus not persistent, the eggs becoming isolated in the parenchyma mostly in the lateral fields of the segment, few in the median field; testicles in lateral fields, absent from the median field; adults in reptiles.**
***Pancerina*, p. 85.**

Uterus persistent ---------- 70

70. **Uterus single or double (one on each side of median line), transversely elongated, tubular, generally with simple anterior and posterior outpocketings; vagina ventral of cirrus pouch on both sides of segment; eggs with or without pyriform apparatus; adults in mammals and birds.**
***Cittotænia*, p. 63.**

Two reticulate uteri which may become more or less fused with one another in the median line; vagina ventral and cirrus dorsal on right-hand side of segment, vice versa on left side; eggs with or without pyriform apparatus; adults in mammals and birds ---------- *Moniezia*, p. 64.

DIAGNOSES OF FAMILIES, SUBFAMILIES, AND GENERA, AND LISTS OF SPECIES OCCURRING IN NORTH AMERICAN BIRDS.

Under each genus are listed the species which have been reported as parasites of North American birds, and references are given to articles in which descriptions of these forms may be found. Species which have been collected in this country, and of which I have examined specimens, are indicated by an asterisk, and the names of hosts from which such specimens were collected are indicated in a similar manner. Among the hosts are included a number of species which are not North American, comprising (1) forms which have been introduced, such as the English sparrow and various game birds, (2) forms which are present in this country in the domesticated state, and (3) forms which are represented in the North American fauna by varieties or subspecies.

Family TETRABOTHRIIDÆ.

***Tetrabothridæ* DIESING, 1850, in part.**

Family diagnosis.—Tænioidea: Scolex unarmed, without rostellum. Suckers with an outwardly projecting auricular appendage on the anterior border. Neck short. Segments of the strobila, with the exception of the hindermost segments, always much broader than long. A single set of reproductive organs in each segment. Genital pores unilateral. Genital cloaca deep. Cirrus pouch small and nearly spherical, united with the genital cloaca by a muscular cloacal canal. Yolk gland in front of the ovary. Eggs with three transparent envelopes. Adults in birds and mammals.

Type-genus.—*Tetrabothrius* Rudolphi, 1819.

Genus TETRABOTHRIUS Rudolphi, 1819.

***Amphoterocotyle* DIESING, 1863 (type, *A. elegans* DIESING, 1863).**
***Prosthecocotyle* MONTICELLI, 1892 (type, *Tænia forsteri* KREFFT, 1871).**
***Bothridiotænia* LÖNNBERG, 1896 (type, *Tænia erostris*, LÖNNBERG, 1889).**

Generic diagnosis.—Tetrabothriidæ: With the characters of the family.

Type-species.—*Bothriocephalus macrocephalus* Rudolphi, 1810.

TETRABOTHRIUS ARCTICUS Linstow, 1901.

For description see LINSTOW, 1901e, pp. 285–286, fig. 42.

Host.—*Somateria mollissima.*

TETRABOTHRIUS CYLINDRACEUS (Rudolphi, 1819) Diesing, 1850.

For description see FUHRMANN, 1899b, pp. 872–873 (*Prosthecocotyle cylindracea*).

Hosts.—*Rissa tridactyla, Larus hyperboreus, Larus marinus, Larus argentatus, Larus canus, Larus atricilla, Xema sabini, Sterna maxima, Uria troile.*

TETRABOTHRIUS DIOMEDEÆ (Fuhrmann, 1900).

For description see SHIPLEY, 1900c, pp. 557–558, pl. 56, figs. 27–29 (*Prosthecocotyle diomedeæ*).

Host.—*Diomedea exulans.*

TETRABOTHRIUS EROSTRIS (Lönnberg, 1889).

For description see FUHRMANN, 1899b, pp. 871–872 (*Prosthecocotyle erostris*).

Hosts.—*Rissa tridactyla, Larus marinus, Larus argentatus, Larus canus, Sterna hirundo, Sterna paradisæa.*

TETRABOTHRIUS HETEROCLITUS Diesing, 1850.

For description see FUHRMANN, 1899b, p. 874 (*Prosthecocotyle heteroclita*); 1899c, pp. 648–650, figs. 4–8 (*Prosthecocotyle heteroclita*).

Hosts.—*Puffinus puffinus, Puffinus kuhli, Priocella glacialoides, Daption capensis, Diomedea exulans, Diomedea albatrus.*

TETRABOTHRIUS MACROCEPHALUS Rudolphi, 1819.

For description see FUHRMANN, 1899b, pp. 873–874 (*Prosthecocotyle macrocephala*).

Hosts.—*Gavia stellata, Gavia arctica, Gavia immer, Colymbus auritus.*

TETRABOTHRIUS MONTICELLII (Fuhrmann, 1899).

For description see FUHRMANN, 1899b, p. 870 (*Prosthecocotyle monticellii*).

Host.—*Fulmarus glacialis.*

TETRABOTHRIUS PELECANI Fuhrmann, 1908.

For description see FUHRMANN, 1899b, pp. 875–876 (*Prosthecocotyle pelecani aquilæ*).

Hosts.—*Sula leucogastra, ?Fregata aquila.*

TETRABOTHRIUS PORRIGENS Molin, 1858.

For description see MOLIN, 1861c, p. 237, pl. 5, figs. 18, 19 (*Tetrabothrium* (*Orygmathobothrium*) *porrigens*).

Host.—*Nycticorax nycticorax.*

TETRABOTHRIUS TORULOSUS Linstow, 1888.

For description see FUHRMANN, 1899c, pp. 643–648, figs. 1–3 (*Prosthecocotyle torulosa*).

Host.—*Diomedea albatrus.*

TETRABOTHRIUS UMBRELLA (Fuhrmann, 1899) Fuhrmann, 1908.

For description see Fuhrmann, 1899b, p. 871 (*Prosthecocotyle umbrella*).

Hosts.—Diomedea exulans, Phœbetria palpebrata.

TETRABOTHRIUS, species.

Listed by Fuhrmann, 1908a, p. 136.

Host.—Sula bassana.

Family MESOCESTOIDIDÆ Fuhrmann, 1907.

Mesocestoidinæ Lühe, 1894.
Mesocestoidæ Ariola, 1899.

Family diagnosis.—Tænioidea: Scolex without rostellum or hooks. Suckers unarmed. A single set of reproductive organs in each segment. Genital pores located in the ventral surface of the segment. Vagina opens in front of or beside the cirrus pouch. Eggs in gravid segments inclosed in a single thick-walled egg-capsule. Adults in mammals and birds.

Type-genus.—Mesocestoides Vaillant, 1863.

Genus MESOCESTOIDES Vaillant, 1863.

Monodoridium Walter, 1866 (type, *Tænia utriculifera* Walter, 1866).
Ptychophysa Hamann, 1885 (type, *Tænia canis-lagopodis* Rudolphi, 1810).

Generic diagnosis.—Mesocestoididæ: With the characters of the family. Adults in mammals and birds.

Type-species.—Mesocestoides ambiguus Vaillant, 1863.

MESOCESTOIDES ALAUDÆ Stossich, 1896.

For description see Stossich, 1896a, p. 133.

Host.—Alauda arvensis.

MESOCESTOIDES PERLATUS (Goeze, 1782) Mühling, 1898.

For description see Mühling, 1898b, pp. 105–108.—Volz, 1900, pp. 156–157.

Hosts.—Cerchneis tinnunculus, Aquila chrysaëtos.

Family ANOPLOCEPHALIDÆ Fuhrmann, 1907.

Family diagnosis.—Tænioidea: Scolex unarmed, without rostellum. Suckers relatively large, unarmed. Neck absent. Segments usually broader than long. A single or double set of reproductive organs in each segment. Genital pores marginal and bilateral, unilateral, or irregularly alternate or (?) absent. Testicles numerous or rarely (*Triplotænia*) one in each lateral half of the segment. Median axis of female glands lateral of the median axis of the segment. Uterus persistent, and transversely elongated, either tubular, sac-like, branched or reticular; or not persistent, replaced by egg capsules whose formation may or may not be preceded by the appearance of para-uterine organs. Egg with thin transparent shells with or without a pyriform apparatus. Adults in mammals and birds.

Type-genus.—Anoplocephala E. Blanchard, 1848.

Subfamily ANOPLOCEPHALINÆ Blanchard, 1891.

Subfamily diagnosis.—Anoplocephalidæ: Uterus persistent and tubular, sac-like, branched or reticular. Adults in mammals and birds.

Type-genus.—*Anoplocephala* E. Blanchard, 1848.

Genus TRIPLOTÆNIA Boas, 1902.

Generic diagnosis.—Anoplocephalinæ: Segmentation of strobila not apparent externally. One ovary, yolk gland, and testicle in each lateral half[a] of the segment, near the border in the neighborhood of the longitudinal excretory vessels and nerve. One vagina in each lateral half of the segment. Four to five cirrus pouches in each lateral half of the segment. Uterus, one in each lateral half of the gravid segment, sac-like, transversely elongated. Egg with well-developed pyriform apparatus, the horns of which are prolonged in two coiled filaments. Adults in marsupials.

Type-species.—*Triplotænia mirabilis* Boas, 1902.

Genus ANOPLOCEPHALA E. Blanchard, 1848.

Plagiotænia PETERS, 1871 (type, *Tænia gigantea* Peters, 1857).

Generic diagnosis.—Anoplocephalinæ: Segments generally much broader than long, occasionally longer than broad. A single set of reproductive organs in each segment. Genital pores unilateral or irregularly alternate. Genital canals pass on the dorsal side of the longitudinal excretory vessels and nerve. Testicles and female glands in the median field; female glands toward the pore side of the segment, testicles toward the opposite side. Uterus a transversely elongated sac with pocket-like appendages, anteriorly and posteriorly. Eggs with well-developed pyriform apparatus. Adults in mammals.

Type-species.—*Anoplocephala perfoliata* (Goeze, 1782) E. Blanchard, 1848.

Genus BERTIELLA Stiles and Hassall, 1902.

Bertia BLANCHARD, 1891 (homonym of *Bertia* ANCEY, 1888, mollusk).

Generic diagnosis.—Anoplocephalinæ: Segments always broader than long. A single set of reproductive organs in each segment. Genital pores regularly or irregularly alternate. Genital canals pass dorsal of longitudinal excretory vessels and usually dorsal of nerve.

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[a] The specimens on which the species *Triplotænia mirabilis* was based each consisted of a head to which apparently two strobilæ were attached. Janicki (1906), however, has shown that this condition is probably teratological, and that the double strobila represents the separated lateral halves of a single strobila.

Testicles dorsal and anterior, extending in an unbroken mass from one side of the median field of the segment to the other as far as the excretory vessels. Uterus transversely elongated with numerous outpocketings, anteriorly and posteriorly. Eggs with or without pyriform apparatus. Adults in birds and mammals.

Type-species.—*Bertiella studeri* (Blanchard, 1891) Stiles and Hassall, 1902.

BERTIELLA DELAFONDI (Railliet, 1892).

For description see STILES, 1896b, p. 57, pl. 20, figs. 257–262 (*Tænia, delafondi*).—FUHRMANN, 1902i, pp. 132–135, figs. 13, 14 (*Bertia delafondi.*—WOLFFHÜGEL, 1904a, pp. 45–48, figs. 1–4 (*Bertia delafondi*).

Hosts.—*Columba livia*, *Columba livia domestica.*

Genus ANDRYA Railliet, 1893.

Generic diagnosis.—Anoplocephalinæ: Segments broader than long or as long as broad. A single set of reproductive organs in each segment. Genital pores irregularly alternate, but mostly upon the same side of the strobila. Testicles in median field. A distinct round or elongated pedunculated prostatic gland near ventral excretory vessel on pore side of median field. Female glands in the median field on the pore side of the median line. Uterus net-like, with forked processes, occasionally somewhat sac-like. Eggs with pyriform apparatus, the horns of which are rather short. Adults in mammals.

Type-species.—*Andrya rhopalocephala* (Riehm, 1881) Stiles, 1895.

Genus CITTOTÆNIA Riehm, 1881.

Ctenotænia RAILLIET, 1893 (type, *Tænia marmotæ* FRÖLICH, 1802).

Cœlodela SHIPLEY, 1900 (type, *Cœlodela kuvaria* SHIPLEY, 1900; see FUHRMANN, 1902i, p. 142).

Generic diagnosis.—Anoplocephalinæ: Segments broader than long. Two sets of reproductive organs in each segment. Genital pores bilateral. Genital canals pass dorsal of longitudinal excretory vessels and nerves. Interproglottidal glands absent. Vagina ventral of cirrus pouch on both sides of segment. Uterus single or double (one on each side of median line), transversely elongated, tubular, generally with simple anterior and posterior outpocketings. Eggs with well-developed pyriform apparatus, the horns of which are long, crossing each other, or in some cases without this apparatus (see Fuhrmann, 1902i, p. 142, *Cittotænia kuvaria*). Adults in mammals and birds.

Type-species.—*Cittotænia latissima* Riehm, 1881=*Cittotænia denticulata* (Rudolphi, 1804) Stiles and Hassall, 1896.

Genus MONIEZIA Blanchard, 1891.

Paronia DIAMARE, 1900 (type, *P. carrinoi* DIAMARE, 1900; see FUHRMANN, 1907a, p. 295).

Generic diagnosis.—Anoplocephalinæ: Segments generally broader than long. Two sets of reproductive organs in each segment with two reticulate uteri which may become more or less fused with one another in the median line. Genital pores bilateral. Genital canals cross on dorsal side of longitudinal excretory vessels and nerves. Interproglottidal glands generally present. Vagina ventral and cirrus dorsal on right side of segment; the reverse on left side. Eggs with three shells and with well-developed pyriform apparatus, the horns of which generally end in a disk, or (in species from birds) without pyriform apparatus. Adults in mammals and birds.

Type-species.—*Moniezia expansa* (Rudolphi, 1810) Blanchard, 1891.

Genus SCHIZOTÆNIA Janicki, 1904.

Generic diagnosis.—Anoplocephalinæ: Segments broader than long. A single set of reproductive organs in each segment. Genital pores alternate. Genital canals pass dorsal of the longitudinal excretory vessels and nerve. Testicles near the posterior border of the segment in a group extending from the longitudinal excretory vessels of one side to those of the other. Cirrus pouch very muscular. Female glands almost median, their longitudinal axis but slightly displaced toward the genital pore. Extreme lateral portions of the uterus become functional early as sac-like enlargements; remainder of uterus develops as a complicated system of irregular lacunæ. Eggs with pyriform apparatus. Adults in mammals.

Type-species.—*Tænia decrescens* Diesing, 1856 (not *T. decrescens* Creplin, 1849).

Genus APORINA Fuhrmann, 1902.

Generic diagnosis.—Anoplocephalinæ: A single set of reproductive organs in each segment. Genital pores (?) absent. Female glands near the side toward which the vagina runs. Testicles dorsal, very numerous, mostly in the lateral portions of the segment on both sides of the longitudinal excretory vessels, extending from the anterior to the posterior border of the segment; very few in the median field. Vagina and rudimentary cirrus pouch (? without external openings). irregularly alternate on right or left side of the strobila, pass dorsal of the excretory vessels and unite with one another in the lateral field of the segment. Uterus median, bilobed, with a prolongation posteriorly on each side, which crosses the longitudinal excretory vessels, and passes forward outside of and parallel with the latter. Eggs with two shells without pyriform apparatus. Adults in birds.

Type-species.—Aporina alba Fuhrmann, 1902.

Subfamily LINSTOWINÆ Fuhrmann, 1907.

Subfamily diagnosis.—Anoplocephalidæ: A single set of reproductive organs in each segment. Uterus breaks down into egg capsules. Adults in mammals and birds.

Type-genus.—Linstowia Zschokke, 1898.

Genus LINSTOWIA Zschokke, 1898.

Generic diagnosis.—Linstowinæ: Segments broader than long. Cortical parenchyma greatly increased in thickness, medullary parenchyma correspondingly reduced. Dorsal longitudinal excretory vessels along the outer side of the ventral vessels. Genital pores alternate. Genital canals pass ventral of the excretory vessels and nerve. Testicles dorsal, scattered throughout the entire length of the segment. Female glands submedian, only slightly displaced toward the pore side of the segment. Uterus a thin-walled folded tube, disappearing early, the eggs becoming inclosed singly in egg capsules. Eggs without pyriform apparatus. Adults in monotremes and marsupials.

Type-species.—Tænia echidnæ W. Thompson, 1893.

Genus ZSCHOKKEELLA, new name.

Linstowia (in part) (see FUHRMANN, 1902l, p. 138).
Zschokkia[a] FUHRMANN, 1902.
Zschokkea[b] FUHRMANN, 1902 (homonymous with *Zschokkea* KOENIKE, 1892,[c] a genus of mites).

Generic diagnosis.—Linstowinæ: Segments much broader than long. Cortical parenchyma and musculature greatly developed. Dorsal excretory vessel lateral of ventral vessel. A fine capillary network in the periphery of the cortical parenchyma connects all four excretory vessels. Genital pores unilateral. Genital canals pass dorsal of the nerve, and ventral of the dorsal excretory vessel. Cirrus pouch weakly developed. Testicles dorsal scattered through the entire length of the segment. Female reproductive glands toward pore side of the segment between dorsal and ventral excretory vessels. Uterus early breaks down into egg capsules. Adults in birds.

Type-species.—Zschokkeella linstowii (Parona, 1885).

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[a] Fuhrmann, 1902l, p. 138, apparently a misprint for *Zschokkea*.

[b] Fuhrmann, 1902l, p. 140.

[c] Zool. Anz., vol. 15, pp. 320–321.

Subfamily THYSANOSOMINÆ Fuhrmann, 1907.

Subfamily diagnosis.—Anoplocephalidæ: Uterus transversely elongated consisting of several or numerous communicating sacs with parenchymatous para-uterine organs, into which the eggs probably pass in the oldest segments. Adults in mammals.

Type-genus.—*Thysanosoma* Diesing, 1835.

Genus THYSANOSOMA Diesing, 1835.

Generic diagnosis.—Thysanosominæ: Segments much broader than long, end segments only showing a tendency to become longer and narrower. A double set of reproductive organs but only a single uterus in each segment, with opposite or with irregularly alternating pores, those of one side, with the corresponding cirrus pouch, ovary, and vagina having been suppressed. Genital canals pass between the longitudinal excretory vessels, and dorsal of the nerve. Uterus transverse, undulating, composed of numerous ascon-like pouches each supplied with a parauterine organ. Horns of pyriform apparatus absent. Adults in mammals (ruminants).

Type-species.—*Thysanosoma actinioides* Diesing, 1835.

Family DAVAINEIDÆ Fuhrmann, 1907.

Family diagnosis.—Tænioidea: Scolex with simple rostellum, armed with double row (rarely a single row) of very numerous (and generally very small) hammer-shaped hooks. Suckers armed or, rarely, unarmed. A single or double set of reproductive organs in each segment. Genital pores marginal, and bilateral, unilateral, or irregularly alternating. Uterus sac-like, persistent; or sac-like or branched, not persistent, replaced either by numerous egg capsules, or by a single egg capsule whose formation is preceded by the appearance of a para-uterine organ. Egg with thin transparent shells. Adults in mammals and birds.

Type-species.—*Davainea* Blanchard and Railliet, 1891.

Subfamily OPHRYOCOTYLINÆ Fuhrmann, 1907.

Subfamily diagnosis.—Davaineidæ: Rostellum,[a] very broad, armed with a double row of hooks on border. Surface of suckers armed only near the anterior border. A single set of reproductive organs

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[a] Fuhrmann (1908a, p. 41) has found that the apical structure, with five depressions, which has been described in different species of *Ophryocotyle*, is really a rostellum with an anterior enlargement which in certain stages of contraction presents the peculiar appearance noticed by various authors.

in each segment. Genital pores irregularly alternate. Uterus saclike, slightly bilobed, persistent. Adults in birds.

Type-genus.—*Ophryocotyle* Friis, 1870.

Genus OPHRYOCOTYLE Friis, 1870.

Generic diagnosis.—Ophryocotylinæ: With the characters of the subfamily.

Type-species.—*Ophryocotyle proteus* Friis, 1870.

OPHRYOCOTYLE INSIGNIS Lönnberg, 1890.

For description see Lönnberg, 1890b, pp. 15–18.—Blanchard, 1891t, pp. 442–443.—Fuhrmann, 1909, pp. 94–97, figs. 1, 2, 4–6.

Host.—*Hæmatopus ostralegus.*

OPHRYOCOTYLE PROTEUS Friis, 1870.

For description see Blanchard, 1891t, pp. 440–442, fig. 20.—Stiles, 1896f, p. 56, pl. 19, figs. 252–255.—Fuhrmann, 1909, fig. 3.

Hosts.—*Ægialitis hiaticula*, *Calidris leucophæa*, *Erolia ferruginea*, *Pelidna alpina*, *Larus canus.*

OPHRYOCOTYLE, species Lönnberg.

Listed by Fuhrmann, 1908a, p. 159.

Host.—*Mergus serrator.*

Subfamily DAVAINEINÆ Braun, 1900.

Subfamily diagnosis.—Davaineidæ: Suckers armed around the periphery with several rings of hooklets which are unstable or persistent. Uterus breaks down into numerous egg capsules, each containing one or more eggs. Para-uterine organs not present. Adults in mammals and birds.

Type-genus.—*Davainea* Blanchard and Railliet, 1891.

Genus DAVAINEA Blanchard and Railliet, 1891.

Bothriotænia, Railliet, 1892 (type, *Dibothrium longicolle* Molin, 1858; see Lühe, 1899c, p. 40).

Generic diagnosis.—Davaineinæ: A single set of reproductive organs in each segment. Genital pores unilateral or occasionally irregularly alternate. Uterus breaks down into egg capsules each containing one or several eggs. Adults in mammals and birds.

Type-species.—*Davainea proglottina* (Davaine, 1860) Blanchard, 1891.

DAVAINEA ANATINA Fuhrmann, 1908.

For description see Fuhrmann, 1909, p. 107, fig. 16.

Host.—*Anas platyrhynchos domestica.*

* **DAVAINEA CESTICILLUS** (Molin, 1858) Blanchard, 1891.

For description see Ransom, 1905b, pp. 283–285, figs. 8, 14, 18, 26, 32.

Hosts.—**Meleagris galllopavo domestica*, **Gallus gallus domesticus.*

DAVAINEA CIRCUMVALLATA (Krabbe, 1869) Blanchard, 1891.

For description see KRABBE, 1869b, p. 343, pl. 10, fig. 295 (*Tænia circumvallata*).—BLANCHARD, 1891t, p. 434, fig. 10.—STILES, 1896f, pp. 47–48, pl. 16, figs. 203–211.—MOLA, 1907, pp. 126–130, figs. 1–7.

Host.—Coturnix coturnix.

*** DAVAINEA COMITATA Ransom, 1909.**

For description see RANSOM, 1909, pp. 15–18, figs. 5–8 (the present paper).

*Hosts.—*Colaptes auratus, *Melanerpes erythrocephalus.*

DAVAINEA CRASSULA (Rudolphi, 1819) Railliet, 1893.

For description see KRABBE, 1869b, pp. 345–346, pl. 10, fig. 301 (*Tænia crassula*); 1882a, p. 363, pl. 2, figs. 66, 67 (*T. crassula*).—STILES, 1896f, pp. 53–54, pl. 18, figs. 243–246.—FUHRMANN, 1909, p. 104, fig. 13.

Hosts.—Columba livia, Columba livia domestica.

*** DAVAINEA ECHINOBOTHRIDA (Mégnin, 1880) Blanchard, 1891.**

For description see RANSOM, 1904b, pp. 55–65, figs. 42, 44, 46, 48, 50, 52; 1905b, pp. 279–283, figs. 6, 7, 13, 17, 20, 25, 31.

Host.— Gallus gallus domesticus.*

DAVAINEA FRIEDBERGERI (Linstow, 1878) Blanchard, 1891.

For description see STILES, 1896f, pp. 52–53, pl. 18, figs. 236–242.

Host.—Phasianus colchicus.

(? DAVAINEA) LONGICOLLIS (Molin, 1858).

For description see STILES, 1896f, pp. 26–27 (*Bothriotænia longicollis*).

Host.—Gallus gallus domesticus.

DAVAINEA MUTABILIS [a] Rüther, 1901.

For description see RÜTHER, 1901b, pp. 353–357, 362–364, figs. 1–12.

Host.—Gallus gallus domesticus.

DAVAINEA PARAECHINOBOTHRIDA [b] Magalhães, 1893.

For description see MAGALHÃES, 1898c, pp. 442–443, 444.

Host.—Gallus gallus domesticus.

DAVAINEA POLYUTERINA Fuhrmann, 1908.

For description see FUHRMANN, 1909, p. 103.

Host.—Coturnix coturnix.

*** DAVAINEA PROGLOTTINA [c] (Davaine, 1860) Blanchard, 1891.**

For description see STILES, 1896f, p. 47, pl. 15, figs. 194–198; pl. 16, figs. 199–202.

Host.— Gallus gallus domesticus.*

*** DAVAINEA RHYNCHOTA Ransom, 1909.**

For description see RANSOM, 1909, pp. 10–15, figs. 1–4 (the present paper).

*Hosts.—*Colaptes auratus, *Melanerpes erythrocephalus.*

*** DAVAINEA TETRAGONA (Molin, 1858) Blanchard, 1891.**

For description see RANSOM, 1904b, pp. 55–65, figs. 41, 43, 45, 47, 49, 51; 1905b, pp. 278–279, figs. 5, 12, 16, 19, 24, 30.

Host.— Gallus gallus domesticus.*

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[a] This form is probably identical with *D. cesticillus*.

[b] This form is perhaps identical with *D. echinobothrida* or *D. tetragona*.

[c] This species has been collected in this country in Pennsylvania (Bureau of Animal Industry Collection, No. 4372) and in Maryland (Bureau of Animal Industry Collection, Nos. 14442, 14522, and 14759).

DAVAINEA VOLZI[a] Fuhrmann, 1905.

For description see FUHRMANN, 1905b, pp. 303–308, pl. 10, figs. 1–7.

Host.—Gallus gallus domesticus.

Genus POROGYNIA[b] Railliet and Henry, 1909.

Linstowia ZSCHOKKE, 1898 (in part; see FUHRMANN, 1907a, p. 293).
Polycœlia FUHRMANN, 1907 (homonymous with *Polycœlia* KING, 1849, Cœlenterata).

Generic diagnosis.—Davaineinæ: Scolex with simple rostellum, armed with three rows of hooks. Segments much broader than long. Cortical parenchyma and longitudinal musculature greatly developed. Dorsal excretory vessels absent. A single set of reproductive organs in each segment. Genital pores unilateral. Genital canals pass dorsal of the longitudinal ventral excretory vessel and nerve. Testicles numerous. Female glands on the pore side of the median line, near the ventral excretory vessel. Yolk gland between the ovary and median line. Uterus with very thin walls, which early disappear. The eggs become inclosed singly in egg capsules, closely packed together filling the medullary parenchyma. Adults in birds.

Type-species.—Porogynia lata (Fuhrmann, 1901).

Genus COTUGNIA Diamare, 1893.

Generic diagnosis.—Davaineinæ: Segments broader than long. Several layers of longitudinal muscles alternating with layers of transverse muscle fibers. A double set of reproductive organs in each segment, close to the longitudinal excretory canals. Genital canals pass dorsal of longitudinal excretory vessels and nerve. Testicles numerous, filling the median field and extending dorsal of the female organs and excretory vessels to the extreme edge of the medullary parenchyma. Uterus breaks down, and the eggs become inclosed singly in egg capsules. Adults in birds.

Type-species.—Cotugnia digonopora (Pasquale, 1890) Diamare, 1893.

COTUGNIA DIGONOPORA (Pasquale, 1890) Diamare, 1893.

For description see STILES, 1896f, p. 30, pl. 1, figs. 1–11.

Host.—Gallus gallus domesticus.

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[a] This species is very similar to and perhaps identical with *Davainea echinobothrida.*

[b] Fuhrmann (1907a) placed the genus *Polycœlia* (=*Porogynia*) in the subfamily Dipylidiinæ, but more recently (1908a, p. 47) in the light of later knowledge concerning the anatomy of its type-species has transferred it to the subfamily Davaineinæ.

Subfamily IDIOGENINÆ Fuhrmann, 1907.

Subfamily diagnosis.—Davaineidæ: Suckers (?) unarmed. A single set of reproductive organs in each segment. Uterus not persistent, sac-like, more or less lobed or much branched. A para-uterine organ develops into which the eggs finally pass. Adults in birds.

Type-genus.—*Idiogenes* Krabbe, 1868.

Genus IDIOGENES Krabbe, 1868.

Generic diagnosis.—Idiogeninæ: Genital pores unilateral. Cirrus pouch very large, with retractor. A para-uterine organ develops in front of the uterus into which the eggs finally pass directly from the latter, and which transforms into a single egg capsule. Adults in birds.

Type-species.—*Idiogenes otidis* Krabbe, 1868.

Genus CHAPMANIA Monticelli, 1893.

Capsodavainea FUHRMANN, 1901 (type, *Capsodavainea tauricollis* (CHAPMAN, 1876) FUHRMANN, 1901).

Generic diagnosis.—Idiogeninæ: Longitudinal musculature greatly developed, consisting of several layers of muscle bundles. Genital pores unilateral. Uterus much branched, disappears, and the eggs become inclosed in numerous egg capsules, and finally are pressed into a large anteriorly located para-uterine organ, which transforms into a single egg capsule. Adults in birds.

Type-species.—*Chapmania tauricollis* (Chapman, 1876) Monticelli, 1893.

Family HYMENOLEPIDIDÆ Railliet and Henry, 1909.

"*Hymenolepidæ*" ARIOLA, 1899 (type-genus, *Hymenolepis*).
Echinocotylidæ[a] ARIOLA, 1899 (type-genus, *Echinocotyle*).
"*Dilepinidæ*" FUHRMANN, 1907 (type-genus, *Dilepis*).

Family diagnosis.—Tænioidea: Scolex with an armed rostellum, or without rostellum. Hooks on rostellum not hammer-shaped. Suckers usually unarmed. A single, or rarely, a double, set of reproductive organs in each segment. Genital pores marginal and bilateral, unilateral, or regularly or irregularly alternate. Egg with thin transparent shells. Adults in mammals, birds, reptiles, and amphibia.

Type-genus.—*Hymenolepis* Weinland, 1858.

Subfamily DIPYLIDIINÆ Stiles, 1896.

Rhynchotænia DIESING, 1850.
Malacolepidota WEINLAND, 1858.

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[a] Echinocotylidæ and Hymenolepidæ are both referred to by Ariola (1899d, p. 166) on the same page, Hymenolepidæ being mentioned first.

Cystoideæ LEUCKART, 1863.
Cystoidei LEUCKART, 1886.
Cystoidotæniæ RAILLIET, 1886.
Microtæniæ CLAUS, 1891.
Dipylidinæ RAILLIET, 1896. (See Stiles, 1906a, p. 48.)
"*Dilepininæ*" FUHRMANN, 1907.
Dilepidinæ RAILLIET and HENRY, 1909.

Subfamily diagnosis.—Hymenolepididæ: Rostellum armed, or, rarely, absent. Suckers unarmed. A single set, or rarely a double set, of reproductive organs in each segment. Uterus sac-like, simple or lobulated, or not persistent, breaking down into numerous egg capsules, each containing one or several eggs. Para-uterine organs not developed. Adults in birds, mammals, and reptiles.

Type-genus.—*Dipylidium* Leuckart, 1863.

Genus DILEPIS Weinland, 1858.

Generic diagnosis.—Dipylidiinæ: Rostellum armed with a double crown of hooks, with long dorsal and short ventral root and long blade. Inner longitudinal muscle layer consisting of numerous bundles. Genital pores unilateral. Genital canals pass dorsal of the longitudinal excretory vessels and nerve. Vas deferens coiled, seminal vesicle not developed. Testicles in medullary portion of segment surrounding the female glands at the sides and behind, typically numerous (40 to 50), but may be reduced in number (7). Uterus sac-like, with few or numerous outpocketings. Adults in birds and mammals.

Type-species.—*Tænia angulata* Rudolphi, 1810 (=*Tænia undula* Schrank, 1788, according to Cohn, 1901b, pp. 288-293).

DILEPIS ATTENUATA (Dujardin, 1845) Fuhrmann, 1908.

For description see DUJARDIN, 1845a, p. 566, pl. 9, fig. S (*Tænia attenuata*).—LINSTOW, 1875a, pp. 184-185, pl. 2, figs. 7, 8 (*Tænia attenuata*).

Hosts.—*Anthus pratensis*, *Passer domesticus*, *Passer montanus*.

DILEPIS CAPRIMULGORUM Fuhrmann, 1908.

For description see FUHRMANN, 1908b, pp. 49-50, fig. 35.

Host.—*Chordeiles virginianus*.

(? DILEPIS) CYLINDRICA Clerc, 1903.

For description see CLERC, 1903, pp. 337-339, pl. 10, figs. 48, 50, 52, 60.

Host.—*Larus canus*.

DILEPIS LIMOSA Fuhrmann, 1907.

For description see FUHRMANN, 1907b, pp. 516-517, fig. 1.

Hosts.—*Numenius phæopus*, *Limosa limosa*.

DILEPIS NYMPHOIDES Clerc, 1903.

For description see CLERC, 1903, pp. 340-341, pl. 10, fig. 70.

Host.—*Pisobia damacensis*.

DILEPIS PAPILLIFERA Fuhrmann, 1908.

For description see FUHRMANN, 1908b, pp. 48–49, figs. 33, 34.

Host.—Florida cærulea.

DILEPIS RETIROSTRIS (Krabbe, 1869) Zschokke, 1903.

For description see KRABBE, 1869b, pp. 282–283, pl. 5, figs. 97–99 (*Tænia retirostris*).

Hosts.—Arenaria interpres, Pelidna alpina.

DILEPIS SCOLECINA (Rudolphi, 1819) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 280–281, pl. 4, figs. 88–90 (*Tænia scolecina*).

Host.—Phalacrocorax carbo.

*** DILEPIS TRANSFUGA [a] (Krabbe, 1869) Fuhrmann, 1908.**

For description see KRABBE, 1869b, p. 281, pl. 4, figs. 91–93 (*Tænia transfuga*).

*Host.—*Ajaia ajaja.*

DILEPIS UNDULA (Schrank, 1788) Cohn, 1900.

For description see VOLZ, 1900, pp. 130–135, pl. 6, figs. 5, 6; pl. 7, fig. 7 (*Dilepis undulata*).

Hosts.—Sturnus vulgaris, Turdus musicus, Pica pica, Corvus corax.

DILEPIS UNILATERALIS [b] (Rudolphi, 1819) Clerc, 1906.

For description see KRABBE, 1869b, pp. 276–278, pl. 4, figs. 79–83 (*Tænia unilateralis*).—CLERC, 1906b, pp. 714–715, figs. 3, 4.

Hosts.—Butorides virescens, Casmerodius egretta, Ardea cinerea.

DILEPIS URCEUS (Wedl, 1856) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 279–280, pl. 4, figs. 85–87 (*Tænia urceus*).

Host.—Plegadis autumnalis.

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[a] This species has been collected a number of times from birds (*Ajaia ajaja*) dying at the National Zoological Park, Washington, D. C. (Bureau of Animal Industry, Helminthological Collection, Nos. 4162, 4163, 4165, 4452.)

[b] This species was first described by Rudolphi (1819a, pp. 696–697). Under the caption *A. Ardeæ virescentis*, he refers to a large specimen about 7 inches long and several small specimens. The description which Rudolphi gives of these specimens indicates that the material comprised more than one species. Krabbe (1869b) redescribed and figured *Tænia unilateralis* on the basis of the small specimens in Rudolphi's original material. Fuhrmann (1906b, p. 740), who reexamined Rudolphi's material, states that the species *T. unilateralis* belongs in *Hymenolepis* and is identical with *H. ardeæ* Fuhrmann (1906b, pp. 451–452, figs. 37–39), the latter name falling as a synonym of *H. unilateralis*.

It should be noted, however, that *Hymenolepis ardeæ*, as described by Fuhrmann (1906b, p. 451), is a species of considerable size, which indicates that Fuhrmann in examining Rudolphi's material did not find the small specimens which Krabbe described as *T. unilateralis*. As the specimens from Rudolphi's collection, which Krabbe described and figured, are quite different from *Hymenolepis ardeæ*, it is evident that the type material of *Tænia unilateralis* originally represented more than one species, Krabbe having studied one form and Fuhrmann another. As Krabbe's description antedates Fuhrmann's, the species which the former author selected as *Tænia unilateralis* should retain that name, rather than the form which Fuhrmann selected. *Dilepis campylancristrota* (Wedl, 1856), which Fuhrmann (1908a, p. 52) accepts as the appropriate name for the form described by Krabbe, falls into synonymy.

Genus TRICHOCEPHALOIDES Sinitsin, 1896.

Generic diagnosis.—Dipylidiinæ: Rostellum with single crown of hooks. Genital pores unilateral, subdorsal. Testicles few, but more than four, in posterior region of segment. Uterus sac-like; eggs few. Adults in birds.

Type-species.—*Trichocephaloides inermis* Sinitsin, 1896 (= *Tænia megalocephala* Krabbe, 1869; see Fuhrmann, 1901a, p. 761, and Clerc, 1902a, p. 662).

TRICHOCEPHALOIDES MEGALOCEPHALA (Krabbe, 1869) Clerc, 1902.

For description see KRABBE, 1869b, pp. 283–284, pl. 5, figs. 100–103 (*Tænia megalocephala*).—CLERC, 1902a, pp. 662–663, fig. 5; 1903, pp. 350–353, pl. 9, fig. 33; pl. 10, fig. 57.

Hosts.—*Totanus totanus, Calidris leucophæa, Pisobia damacensis, Erolia ferruginea, Pelidna alpina, Arquatella maritima.*

Genus LATERIPORUS Fuhrmann, 1907.

Generic diagnosis.—Dipylidiinæ: Rostellum armed with a single crown of 12 to 16 hooks (120 to 170μ long), with long dorsal and short ventral root, and well-developed blade. Genital pores unilateral. Genital canals pass dorsal of the longitudinal excretory vessels. Testicles 12 to 30 in number, behind, or at the sides of, the female glands. Uterus sac-like, filling the entire medullary parenchyma in gravid segments. Adults in birds.

Type-species.[a]—*Lateriporus teres* (Krabbe, 1869) Fuhrmann, 1907.

LATERIPORUS BIUTERINUS Fuhrmann, 1908.

For description see FUHRMANN, 1908b, pp. 56–58, figs. 44–46.

Hosts.—*Oidemia fusca, Cairina moschata, Dendrocygna autumnalis.*

LATERIPORUS TERES (Krabbe, 1869) Fuhrmann, 1907.

For description see KRABBE, 1869b, pp. 284–285, pl. 5, figs. 106–108 (*Tænia teres*).—FUHRMANN, 1907b, pp 521–523, figs. 13–15.

Hosts.—*Somateria mollissima, Harelda hyemalis.*

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[a] Fuhrmann in his original publication on this genus (1907b, p. 521) did not select a type-species. He refers only to two species *Lateriporus teres* (Krabbe) and *Lateriporus propeteres* Fuhrmann, hence one of these under the International Code of Nomenclature must be the type. Fuhrmann (1908b, p. 54; 1908a, p. 53) has selected *L. spinosus* Fuhrmann, 1908, as type, a selection which evidently can not stand, since this species is not one of the original species of the genus.

Genus CHOANOTÆNIA[a] Railliet, 1896.

Monopylidium FUHRMANN, 1899 (type, *Davainea musculosa* FUHRMANN, 1896; in part).
Icterotænia RAILLIET and HENRY, 1909 (in part).

Generic diagnosis.—Dipylidiinæ: Rostellum armed with a single crown of hooks usually with long dorsal and short ventral root. Segments numerous, rarely less than 30. Genital pores irregularly alternate near the anterior border of the segment. Genital canals pass between the longitudinal excretory vessels and dorsal of the nerve. Vas deferens coiled, seminal vesicle absent. Testicles numerous, in the posterior region of the segment, or, also, laterally on each side of the female glands. Uterus persistent, sac-like, but may be subdivided into numerous small communicating chambers incompletely separated by partitions infolded from the wall of the uterus, so that in some cases the eggs appear almost as if isolated in the parenchyma. Adults in birds and mammals.

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[a] Although Fuhrmann (1908a, 1907a) and Clerc (1903) recognize *Monopylidium* and *Choanotænia* as distinct genera, they would place *Ch. infundibuliformis*, the type of *Choanotænia* in *Monopylidium*, and Fuhrmann (1908a) has selected *Choanotænia galbulæ* (Zeder, 1803) as a new type for *Choanotænia*. This arrangement, as has been pointed out by Railliet and Henry (1909, p. 338), is in violation of the law of priority of the International Code of Zoological Nomenclature, inasmuch as a type once fixed can not be changed. *Monopylidium* must fall into synonymy if *Ch. infundibuliformis* (type of *Choanotænia*) is made congeneric with *Monopylidium musculosum* (type of *Monopylidium*), *Choanotænia* (1893) being of date prior to that of *Monopylidium* (1899). If, as Clerc and Fuhrmann believe, *Ch. infundibuliformis* and *M. musculosum* should go into the same genus, that genus must be known as *Choanotænia*, not as *Monopylidium*. Such action would leave the genus *Choanotænia* of Fuhrmann (not Railliet) without a name, and it would become necessary to rename the genus. This Railliet and Henry (1909, p. 338) have done, proposing the name *Icterotænia* for the species "*Icterotænia galbulæ, porosa, parina*, etc." Until, however, a more careful comparative study of the various species of *Monopylidium* and *Choanotænia*, especially the type species of the two genera, has been made I believe it justifiable to recognize both these generic names, notwithstanding this necessitates the separation of *Choanotænia infundibuliformis* and *Monopylidium musculosum*, which Clerc and Fuhrmann would place together. I am inclined to doubt that the uterus of the former species breaks down into egg capsules as Clerc (1903) has stated. My own observations support those of Cohn (1901b), who affirms that the uterus is persistent, and possesses an irregularly lobulated cavity incompletely subdivided by infoldings from the wall. If this is true, and if no later development of egg capsules occurs, *Choanotænia infundibuliformis* differs from *Monopylidium*, in which the uterus is said to break down into egg capsules, and it is therefore possible to recognize both *Choanotænia* and *Monopylidium* changing but slightly Fuhrmann's arrangement of species, namely removing *Choanotænia infundibuliformis* from *Monopylidium* to *Choanotænia*, where it belongs. I have not considered the differences between *Monopylidium* and such genera as *Choanotænia*, and *Anomotænia*, sufficiently marked to warrant placing them in different subfamilies, as Fuhrmann (1907a, 1908a) has done. *Monopylidium*, in spite of the breaking down of the uterus, seems to me much more closely related to the genera named than to *Dipylidium*, with which Fuhrmann has united it in a subfamily separate from the others.

Type-species.—*Choanotænia infundibuliformis*[a] (Goeze, 1782) Railliet, 1896 = *Tænia infundibulum* Bloch, 1779.

CHOANOTÆNIA BILATERALIS Fuhrmann, 1908.

For description see FUHRMANN, 1908a, pp. 32–33, figs. 9, 10.

Host.—*Colymbus dominicus.*

CHOANOTÆNIA BOREALIS (Linstow, 1905) Fuhrmann, 1908.

For description see LINSTOW, 1905dd, pp. 11–12, pl. 2, fig. 41; pl. 3, figs. 42, 43 (*Aporina borealis*).—FUHRMANN, 1908a, p. 55.

Host.—*Harelda hyemalis.*

CHOANOTÆNIA CORONATA (Creplin, 1829) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 275–276, pl. 3, figs. 74–76 (*Tænia coronata*).

Host.—*Ægialitis nivosa.*

CHOANOTÆNIA DODECACANTHA (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 261, pl. 1, figs. 14, 15 (*Tænia dodecacantha*).

Host.—*Larus minutus.*

CHOANOTÆNIA EMBRYO (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 273–274, pl. 3, figs. 65, 66 (*Tænia embryo*).

Hosts.—*Gallinago gallinago, Scolopax rusticola.*

*** CHOANOTÆNIA INFUNDIBULUM (Bloch, 1779) Cohn, 1899.**

For description see COHN, 1901b, pp. 365–368, pl. 31, fig. 46; pl. 32, fig. 47.—CLERC, 1903, pp. 354–356, pl. 11, figs. 72, 74–76, 83 (*Monopylidium infundibuliformis*).—RANSOM, 1905b, pp. 276–277, figs. 4, 11, 15, 23, 29 (*Choanotænia infundibuliformis*).

Hosts.—* *Gallus gallus domesticus, Phasianus colchicus, Coturnix coturnix.*

CHOANOTÆNIA INVERSA (Rudolphi, 1819) Fuhrmann, 1908.

For description see RUDOLPHI, 1819a, pp. 156, 510–511 (*Tænia inversa*).—VILLOT 1875, p. 475, pl. 12, fig. 8 (*Tænia inversa*).

Host.—*Sterna paradisæa.*

CHOANOTÆNIA LÆVIGATA (Rudolphi, 1819) Clerc, 1906.

For description see KRABBE, 1869b, p. 275, pl. 3, figs. 71–73 (*Tænia lævigata*).—CLERC, 1906b, pp. 719–720, figs. 16, 17.

Hosts.—*Charadrius apricarius, Ægialitis hiaticula, Ægialitis nivosa.*

CHOANOTÆNIA PARADOXA (Rudolphi, 1802) Clerc, 1903.

For description see KRABBE, 1869b, pp. 274–275, pl. 3, figs. 69, 70 (*Tænia paradoxa*).—CLERC, 1903, pp. 327–332, pl. 10, figs. 53, 55, 61, 62.

Hosts.—*Hæmatopus ostralegus, Charadrius apricarius, Erolia ferruginea, Gallinago gallinago, Scolopax rusticola, Lobipes lobatus.*

CHOANOTÆNIA PARINA (Dujardin, 1845) Clerc, 1906.

For description see DUJARDIN, 1845a, p. 598, pl. 9, fig. E (*Tænia parina*).—KRABBE, 1869b, pp. 341–342, pl. 10, figs. 291, 292 (*Tænia parina*).—CLERC, 1906b, p. 719, fig. 15.

Hosts.—*Passer domesticus, Passer montanus, ? Sturnus vulgaris.*

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[a] According to the law of priority the correct name of this species is *Choanotænia infundibulum* (Bloch, 1779).

CHOANOTÆNIA POROSA (Rudolphi, 1810) Cohn, 1899.

For description see KRABBE, 1869b, pp. 260–261, pl. 1, figs. 10–13 (*Tænia porosa*).—COHN, 1901b, pp. 368–372, pl. 32, figs. 48–50.—CLERC, 1903, p. 320, pl. 11, fig. 86.

Hosts.—Rissa tridactyla, Larus marinus, Larus argentatus, Larus californicus, Larus canus, Larus minutus, Sterna hirundo.

CHOANOTÆNIA STELLIFERA (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 274, pl. 3, figs. 67, 68 (*Tænia stellifera*); 1882a, p. 352, pl. 1, fig. 8 (*T. stellifera*).

Host.—Scolopax rusticola.

CHOANOTÆNIA STERNINA (Krabbe, 1869) Clerc, 1903.

For description see KRABBE, 1869b, pp. 259–260, pl. 1, figs. 7–9 (*Tænia sternina*).—CLERC, 1903, pp. 320–321.

Hosts.—Larus canus, Sterna hirundo, Sterna paradisæa.

Genus MONOPYLIDIUM[a] Fuhrmann, 1899.

Generic diagnosis.—Dipylidiinæ: Rostellum armed with a double or single crown of hooks. A single set of reproductive organs in each segment. Genital pores irregularly alternate, rarely unilateral. Genital canals pass between the longitudinal excretory vessels and dorsal of the longitudinal nerve or dorsal of both excretory vessels. Testicles numerous (20 to 40 or more), behind the female glands or, also, laterally on both sides of the latter. Vas deferens coiled; seminal vesicle absent. Uterus breaks down into egg capsules, each containing one or several eggs. Adults in birds.

Type-species.—Monopylidium musculosum (Fuhrmann, 1896) Fuhrmann, 1899.

MONOPYLIDIUM CINGULIFERUM (Krabbe, 1869) Clerc, 1902.

For description see KRABBE, 1869b, p. 272, pl. 3, figs. 59, 60 (*Tænia cingulifera*).—CLERC, 1903, pp. 356–359, pl. 9, fig. 43; pl. 10, figs. 49, 51.

Hosts.—Ægialitis dubia, Totanus totanus, Machetes pugnax, Pisobia damacensis.

MONOPYLIDIUM MACRACANTHUM Fuhrmann, 1907.

For description see FUHRMANN, 1907b, pp. 530–531, fig. 33.

Host.—Helodromas ochropus.

MONOPYLIDIUM MUSCULOSUM (Fuhrmann, 1896) Fuhrmann, 1899.

For description see FUHRMANN, 1896n, pp. 122–127, pl. 4, figs. 6–9 ([?*Davainea*] *musculosa*); 1899f, pp. 622–627.

Host.—Sturnus vulgaris.

MONOPYLIDIUM PASSERINUM Fuhrmann, 1907.

For description see FUHRMANN, 1907b, pp. 528–529, figs. 28, 29.

Host.—Passer domesticus.

MONOPYLIDIUM ROSTELLATUM Fuhrmann, 1908.

For description see FUHRMANN, 1908b, pp. 63–65, fig. 52

Host.—Himantopus mexicanus.

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[a] See footnote under *Choanotænia*, p. 74.

Genus ANOMOTÆNIA Cohn, 1900.

Choanotænia "COHN" of CLERC, 1903.
Diplochetos LINSTOW, 1906 (type, *D. volvulus* LINSTOW, 1906).

Generic diagnosis.—Dipylidiinæ: Rostellum with double crown of hooks, with long dorsal and short ventral root, and long blade. Genital pores irregularly alternate near anterior border of segment. Genital canals pass between the longitudinal excretory vessels and dorsal of the nerve. Vas deferens coiled, seminal vesicle absent. Testicles numerous, in posterior portion of segment, or, also, laterally on both sides of the female glands. Uterus sac-like. Adults in birds and mammals.

Type-species.—*Anomotænia microrhyncha* (Krabbe, 1869) Cohn, 1900.

ANOMOTÆNIA ACOLLUM Fuhrmann, 1907.

For description see FUHRMANN 1907b, pp. 517-518, fig. 2.

Host.—*Crotophaga ani.*

ANOMOTÆNIA ÆGYPTIACA (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE 1869b, pp. 272-273, pl. 3, fig. 61, 62 (*Tænia ægyptiaca*).—CLERC, 1903, pp. 333-334 (*Choanotænia ægyptiaca*).

Hosts.—*Scolopax rusticola, Gallinago gallinago.*

ANOMOTÆNIA ARIONIS (Siebold, 1850) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 268-269, pl. 2, fig. 47 (*Tænia arionis*).—CLERC, 1903, p. 333 (*Choanotænia arionis*).

Hosts.—*Totanus melanoleucus, Totanus flavipes, Helodromas ochropus.*

ANOMOTÆNIA AURITA (Rudolphi, 1819) Fuhrmann, 1908.

For description see RUDOLPHI, 1819a, pp. 697, 698-699 (*Tænia aurita*).

Host.—*Florida cærulea.*

ANOMOTÆNIA BACILLIGERA (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 273, pl. 3, figs. 63, 64 (*Tænia bacilligera*).

Hosts.—*Gallinago gallinago, Scolopax rusticola.*

ANOMOTÆNIA BOREALIS (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 338, pl. 10, figs. 282, 283 (*Tænia borealis*).—CLERC, 1906b, pp. 718-719, figs. 12-14 (*Choanotænia borealis*).

Hosts.—*Motacilla alba, Plectrophenax nivalis.*

ANOMOTÆNIA CAMPYLACANTHA (Krabbe, 1869) Zschokke, 1903.

For description see KRABBE, 1869b, p. 263, pl. 1, figs. 22-24 (*Tænia campylacantha*).

Host.—*Cepphus grylle.*

ANOMOTÆNIA CINGULATA[a] (Linstow, 1905) Fuhrmann, 1908.

For description see LINSTOW, 1905dd, p. 9, pl. 2, figs. 32-34 (*Dilepis cingulata*).

Host.—*Pelidna alpina.*

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[a] This species is perhaps the same as *Anomotænia clavigera*. (See Fuhrmann, 1908a, p. 57)

ANOMOTÆNIA CITRUS (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 270, pl. 2, figs. 48–50 (*Tænia citrus*).—CLERC, 1903, p. 321 (*Choanotænia citrus*).

Host.—Gallinago gallinago.

ANOMOTÆNIA CLAVIGERA (Krabbe, 1869) Cohn, 1900.

For description see KRABBE, 1869b, p. 267, pl. 2, figs. 41–43 (*Tænia clavigera*).—COHN, 1901b, p. 405.

Hosts.—Arenaria interpres, Pisobia damacensis, Pelidna alpina, Tringa canutus.

***ANOMOTÆNIA CONSTRICTA (Molin, 1858).**

For description see KRABBE, 1869b, p. 329, pl. 9, figs. 252–256 (*Tænia constricta*).—VOLZ, 1900, pp. 117-126, pl. 6, figs. 1-3 (*T. constricta*).—COHN, 1901b, pp. 405–407 (*Anomotænia puncta*).—CLERC, 1903, pp. 334–335 (*Choanotænia constricta*).

*Hosts.—Turdus musicus, *Pica pica,*[a] **Corvus ossifragus,*[b] **Corvus brachyrhynchos,*[c] *Corvus corax.*

ANOMOTÆNIA CYATHIFORMIS (Frölich, 1791) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 330–331, pl. 9, fig. 260 (*Tænia cyathiformis*)

Host.—Riparia riparia.

ANOMOTÆNIA ERICETORUM (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 270–271, pl. 3, figs. 51, 52 (*Tænia ericetorum*).

Host.—Charadrius apricarius.

ANOMOTÆNIA GLOBULUS (Wedl, 1856) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 271, pl. 3, figs. 53–55 (*Tænia globulus*).—CLERC, 1903, pp. 323-325 (*Choanotænia globulus*).

Hosts.—Helodromas ochropus, Machetes pugnax.

ANOMOTÆNIA HIRUNDINA Fuhrmann, 1907.

For description see FUHRMANN, 1907b, p. 518, figs. 5, 6.

Host.—Riparia riparia.

ANOMOTÆNIA LARINA (Krabbe, 1869) Zschokke, 1903.

For description see KRABBE, 1869b, pp. 261-262, pl. 1, figs. 16, 17 (*Tænia larina*).

Hosts.—Rissa tridactyla, Larus hyperboreus.

ANOMOTÆNIA MICRACANTHA (Krabbe, 1869) Zschokke, 1903.

For description see KRABBE, 1869b, pp. 262–263, pl. 1, figs. 18–21 (*Tænia micracantha*).

Hosts.—Pagophila alba, Rissa tridactyla, Larus hyperboreus, Larus marinus, Larus canus, Cepphus grylle.

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[a] Bureau of Animal Industry Helminthological Collection, No. 3656 from *Pica pica hudsonia*, Montana.

[b] Bureau of Animal Industry Helminthological Collection, No. 2752.

[c] U. S. National Museum Helminthological Collection, Nos. 5956, 5988, 6003.

ANOMOTÆNIA MICROPHALLOS (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 266, pl. 2, figs. 35–37 (*Tænia microphallos*).—CLERC, 1903, pp. 336–337 (*Choanotænia microphallos*).

Hosts.—Vanellus vanellus, Pisobia damacensis.

ANOMOTÆNIA MICRORHYNCHA (Krabbe, 1869) Cohn, 1900.

For description see KRABBE, 1869b, p. 266, pl. 2, figs. 38–40 (*Tænia microrhyncha*).—COHN, 1901b, pp. 403–405.

Hosts.—Charadrius apricarius, Ægialitis hiaticula, Ægialitis dubia, Machetes pugnax.

ANOMOTÆNIA MUTABILIS (Rudolphi, 1819) Fuhrmann, 1907.

For description see FUHRMANN, 1907b, pp. 517–518, figs. 3, 4.

Host.—Crotophaga ani.

ANOMOTÆNIA NYMPHÆA (Schrank, 1790) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 264–266, pl. 2, figs. 30–34 (*Tænia nymphæa*).

Hosts.—Numenius borealis, Numenius phæopus, Bartramia longicauda.

ANOMOTÆNIA PLATYRHYNCHA (Krabbe, 1869) Cohn, 1900.

For description see KRABBE, 1869b, pp. 271–272, pl. 3, figs. 56–58 (*Tænia platyrhyncha*).—COHN, 1901b, pp. 400–403, pl. 34, fig. 80.

Hosts,—Totanus totanus, Pisobia damacensis.

ANOMOTÆNIA PYRIFORMIS (Wedl, 1856) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 264, pl. 2, figs. 28, 29 (*Tænia pyriformis*).

Host.—Crex crex.

ANOMOTÆNIA SLESVICENSIS (Krabbe, 1882) Fuhrmann, 1908.

For description see KRABBE, 1882a, p. 352, pl. 1, fig. 9 (*Tænia slesvicensis*).

Hosts.—Gallinago gallinago, Scolopax rusticola.

ANOMOTÆNIA SOCIABILIS, new name.[a]

For description see KRABBE, 1869b, p. 258, pl. 1, figs. 1–3 (*Tænia socialis*).

Host.—Uria troile.

ANOMOTÆNIA TORDÆ (Fabricius, 1780) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 259, pl. 1, figs. 4–6 (*Tænia armillaris*).

Hosts.—Uria troile, Alca torda.

ANOMOTÆNIA TRIGONOCEPHALA (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 339, pl. 10, figs. 284–286 (*Tænia trigonocephala*).

Host.—Saxicola œnanthe.

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[a] New name for *A. socialis* (Krabbe, 1869) Fuhrmann, 1908. *Tænia socialis* Krabbe, 1869 is a homonym of *Tænia socialis* Retzius, 1786.

ANOMOTÆNIA VARIABILIS[a] (Rudolphi, 1802).

For description see KRABBE, 1869b, pp. 267-268, pl. 2, figs. 44-46 (*Tænia variabilis*).—CLERC, 1903, pp. 321-323 (*Choanotænia variabilis*).

Hosts.—*Vanellus vanellus*, *Squatarola squatarola*, *Totanus totanus*, *Erolia ferruginea*, *Pelidna alpina*, *Gallinago gallinago*, *Philohela minor*.

Genus AMŒBOTÆNIA Cohn, 1899.

Generic diagnosis.—Dipylidiinæ: Rostellum with a single crown of hooks. Neck absent. Segments few (not over 30), much broader than long. Genital pores regularly alternate. Testicles rather numerous (12 or more), in posterior portion of segment. Uterus saclike, fills entire medullary portion of gravid segment. Adults in birds.

Type-species.—*Amœbotænia sphenoides* (Railliet, 1892) Cohn, 1899.

AMŒBOTÆNIA BREVIS (Linstow, 1884) Fuhrmann, 1908.

For description see LINSTOW, 1884a, p. 143, figs. 33, 34 (*Tænia brevis*).

Hosts.—*Squatarola squatarola*, *Charadrius apricarius*, *Ægialitis hiaticula*.

***AMŒBOTÆNIA SPHENOIDES**[b] (Railliet, 1892) Cohn, 1899.

For description see COHN 1901b, pp. 381-385, pl. 33, figs. 57-59 (*Amœbotænia cuneata*).

Host.—**Gallus gallus domesticus*.

Genus LIGA Weinland, 1857.

Fuhrmannia PARONA, 1901 (type, *F. brasiliensis* PARONA).

Generic diagnosis.—Dipylidiinæ: Rostellum armed with a double crown of hooks with long dorsal and short ventral root. Strobila with 12 to 16 segments. Genital pores regularly alternate; located

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[a] Frölich (1802a, pp. 86-87, pl. 2, figs. 23-25) described a species under the name of *Tænia stentorea* from *Tringa hypoleucos*, which Rudolphi (1819a, p. 498) considers identical with *Tænia variabilis*. The name *stentorea* should replace *variabilis* if it can be proved that Frölich's paper appeared prior to Rudolphi's paper of 1802, otherwise the species should continue to be known as *variabilis*.

[b] *Synonomy*—*Tænia cuneata* Linstow, 1872, not Batsch, 1786; *Tænia sphenoides* Railliet, 1892; *Dicranotænia cuneata* (Linstow, 1872) Railliet, 1893; *Dicranotænia sphenoides* (Railliet, 1892) Railliet, 1896; *Amœbotænia sphenoides* (Railliet, 1892) Cohn, 1899; *Amœbotænia cuneata* (Linstow, 1872) Cohn, 1901.

This species has been fully described by Cohn (1901b) under the erroneous name *Amœbotænia cuneata*. *Tænia cuneata* Linstow, 1872, is a homonym of *Tænia cuneata* Batsch, 1786; hence, under the International Code of Zoological Nomenclature, the name *cuneata* can not be used for the species described by Linstow in any generic combination whatsoever.

Amœbotænia sphenoides has been found in this country in Maryland and the District of Columbia (Bureau of Animal Industry Helminthological Collection Nos. 14521, 14713, 14746).

in the anterior third of the segment. Genital canals pass dorsal of excretory vessels and nerve. Testicles about 18 in number, located posterior of the female glands. Vas deferens much coiled, in the anterior portion of the segment, without vesicular enlargement. Ovary a simple sac, median, in anterior half of segment. Yolk gland a simple sac posterior of ovary. Uterus thin-walled, much lobulated, occupying most of the medullary portion of the gravid segment. Outer shell of the egg with a tubular prolongation at each pole terminating in a globular expansion. Adults in birds.

Type-species.—*Liga punctata*[a] (Weinland, 1856) Weinland, 1857= *Liga brasiliensis* (Parona, 1901) Ransom, 1909.

***LIGA BRASILIENSIS (Parona, 1901) Ransom, 1909.**

For description see FUHRMANN, 1907b, p. 521, fig. 12 (*Fuhrmannia brasiliensis*).—RANSOM, 1909, pp. 22–25, figs. 9–14 (the present paper).

Host.—**Colaptes auratus.*

Genus LEPTOTÆNIA Cohn, 1901.

Generic diagnosis.—Dipylidiinæ: Scolex relatively very large. Rostellum armed with a single crown of hooks with long dorsal root and short ventral root, and rather short blade. Neck absent. Segments few (12 to 15). Genital pores regularly alternate. Reproductive organs protogynous in development. Testicles rather numerous (12 to 15), lateral in position toward the pore side of segment. Cirrus pouch and cirrus very long. Uterus sac-like, fills entire gravid segment. Adults in birds.

Type-species.—*Leptotænia ischnorhyncha* (Lühe, 1898) Cohn, 1901.

Genus PARVIROSTRUM[b] Fuhrmann, 1907.

Generic diagnosis.—Dipylidiinæ: Strobila small, division into segments not well marked. Scolex large, rostellum small, armed with double crown of hooks. Genital pores irregularly alternate. Reproductive glands very small. Testicles in lateral portions of segment. Ovary and yolk gland toward pore side of segment. Uterus sac-like. Adults in birds.

Type-species.—*Parvirostrum reticulatum* Fuhrmann, 1908.

Genus CYCLUSTERA Fuhrmann, 1901.

Generic diagnosis.—Dipylidiinæ: Rostellum with double crown of hooks. Longitudinal musculature in three layers. Genital pores regu-

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[a] As *Liga punctata* is invalid (see p. 21), and *Liga brasiliensis* is the next available name, the latter is the correct designation of this species.

[b] This genus was first mentioned without description or designation of type by Fuhrmann in 1907 (1907a, p. 292), and was first described in 1908 (1908b, p. 60), *P. reticulatum* being the only species.

larly alternate. Genital canals pass between the longitudinal excretory vessels and open into a very muscular cloacal canal. Testicles numerous, scattered throughout the entire dorsal medullary portion of the segment. Ovary and yolk gland surrounded by a ring-like uterus with secondary branches. Eggs with two shells. Adults in birds.

Type-species.—*Tænia capito* Rudolphi, 1819.

*** CYCLUSTERA CAPITO**[a] (Rudolphi, 1819) Fuhrmann, 1901.

For description see KRABBE, 1869b, pp. 281–282, pl. 4, figs. 94, 95 (*Tænia capito*).

Host.—**Ajaia ajaja.*

Genus LATEROTÆNIA Fuhrmann, 1906.

Generic diagnosis.—Dipylidiinæ: Rostellum simple, armed with a double crown of hooks. Genital pores irregularly alternate. Genital canals pass dorsal of the ventral excretory vessel, and ventral of the dorsal excretory vessel and longitudinal nerve. Testicles numerous, in lateral portions of segment in the region of the longitudinal excretory vessels. Female glands toward the pore side of the segment in the lateral portion of the medullary parenchyma. Uterus sac-like. Eggs with two envelopes. Adults in birds.

Type-species.—*Laterotænia natteri* Fuhrmann, 1906 = *Laterotænia nattereri* Fuhrmann, 1908 (orthographic emendation).

Genus PROORCHIDA[b] Fuhrmann, 1907.

Generic diagnosis.—Dipylidiinæ: Scolex armed with a double crown of hooks. Genital pores unilateral. Testicles in front of the female glands. Uterus much lobulated (?). Adults in birds.

Type-species.—*Proorchida lobata* Fuhrmann, 1908.

Genus CYCLORCHIDA Fuhrmann, 1907.

Generic diagnosis.—Dipylidiinæ: Rostellum armed with a double crown of hooks, which have a very large dorsal root and small hook portion. Genital pores unilateral. Genital canals pass between the longitudinal excretory vessels. Cirrus pouch communicating with the genital cloaca by a narrow canal opening upon a large papilla. Testicles very numerous, entirely surrounding the female genital glands. Uterus ventral, growing laterally between the excretory vessels into the cortical parenchyma. Adults in birds.

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[a] This species, originally described by Rudolphi on the basis of specimens collected in Brazil, has been found in the same host, *Ajaia ajaja* (Bureau of Animal Industry, Helminthological Collection No. 4164), in this country, at the National Zoological Park, Washington, D. C., where the bird had been brought from Texas. Fuhrmann (1908a, p. 138), probably through error, lists *C. capito* in *Platalea leucerodia*, but not in *Ajaia ajaja*.

[b] This genus was first mentioned by Fuhrmann in 1907 (1907a, p. 292), but was not described nor was the type designated until 1908 (1908b, p. 59).

Type-species.—*Cyclorchida omalancristrota* (Wedl, 1856) Fuhrmann, 1907.

Genus GRYPORHYNCHUS[a] Nordmann, 1832.

Acanthocirrus FUHRMANN, 1907 (type, *A. macrorostratus* FUHRMANN, 1907).

Generic diagnosis.—Dipylidiinæ: Rostellum armed. Genital pores unilateral. Genital canals pass between the longitudinal excretory vessels. Root of cirrus with one or two pairs of powerful spines lying in special pockets. Testicles few (6 to 8). Uterus sac-like. Adults in birds.

Type-species.—*Gryporhynchus pusillus* Nordmann, 1832 = larva of *Acanthocirrus macropeos* (Wedl, 1856).

GRYPORHYNCHUS PUSILLUS Nordmann, 1832.

For description see KRABBE, 1869b, p. 279, fig. 84 (*Tænia macropeos* Wedl).

Host.—*Nycticorax nycticorax.*

GRYPORHYNCHUS CHEILANCRISTROTUS (Wedl, 1856).

For description see CLERC, 1906b, pp. 716–718, figs. 7-11 (*Dilepis macropeos*).[b]

Host.—*Ardea cinerea.*

GRYPORHYNCHUS MACROROSTRATUS (Fuhrmann, 1907).

For description see FUHRMANN, 1907b, pp. 527-528, figs. 24-27 (*Acanthocirrus macrorostratus*).

Host.—*Anthus pratensis.*

Genus ANGULARIA Clerc, 1906.

Generic diagnosis.—Dipylidiinæ: Rostellum armed with a zigzag crown of numerous hooks (about 50). Genital pores irregularly

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[a] *Acanthocirrus*, described by Fuhrmann (1907b) for the two species *A. macrorostratus* (designated as type by Fuhrmann, 1908a, p. 63) and *Dilepis macropeos* (Wedl) of Clerc, 1906 falls into synonymy. Fuhrmann (1908a, p. 63) lists the following species in *Acanthocirrus: A. macrorostratus, A. cheilancristrota* (Wedl, 1856)=*Dilepis macropeos* (Wedl) of Clerc, and *A. macropeos* (Wedl, 1856). Krabbe (1869b, p. 279) who examined Wedl's original specimens of *Tænia macropeos*, states that in the shape and size of the hooks they correspond so exactly to *Gryporhynchus pusillus* that the latter must be considered the larval form of *Tænia macropeos*. Now as *Gryporhynchus pusillus* described in 1832 by Nordmann is the only original and hence type-species of *Gryporhynchus*, this generic name takes precedence over any later genus in which its type may be placed. Accordingly the placing of *Tænia macropeos* Wedl=*Gryporhynchus pusillus* in *Acanthocirrus* necessitates the dropping of the name *Acanthocirrus*.

[b] The form which Clerc describes and figures under the name *Dilepis macropeos*, according to Fuhrmann (1908a, p. 63), is in reality the species *Tænia cheilancristrota* Wedl, 1856.

alternate. Genital canals pass dorsal of the longitudinal excretory vessels. Vas deferens coiled, seminal vesicle absent. Testicles 20 to 25 in the posterior portion of the segment. Uterus with very irregular lobulations. Adults in birds.

Type-species.—*Angularia beema* Clerc, 1906.

ANGULARIA BEEMA Clerc, 1906.

For description see CLERC, 1906b, pp. 728–730, figs. 27–31.

Host.—*Riparia riparia.*

Genus CATENOTÆNIA[a] Janicki, 1904.

Cladotænia COHN, 1901 (in part).

Generic diagnosis.—Dipylidiinæ: Scolex unarmed, without rostellum. Segments considerably longer than broad. A single set of reproductive organs in each segment. Genital pores irregularly alternate. Genital canals pass dorsal of longitudinal excretory vessels and nerve. Testicles numerous, in posterior portion of segment. Female glands in anterior portion. Uterus consists of a median stem and lateral branches. Adults in mammals.

Type-species.—*Catenotænia pusilla* (Goeze, 1782) Janicki, 1904.

Genus DIPYLIDIUM Leuckart, 1863.

Generic diagnosis.—Dipylidiinæ: Rostellum armed with several rings of rose-thorn hooklets, which usually have a discoidal base. Suckers unarmed. Gravid segments generally longer than broad. A double set of reproductive organs in each segment. Genital pores double and opposite. Testicles very numerous, scattered throughout entire medullary parenchyma. Vas deferens coiled, seminal vesicle absent. Uterus at first reticular, later breaking up into egg capsules, each containing one or more eggs. Eggs with two shells. Adults in mammals and birds.

Type-species.—*Dipylidium caninum* (Linnæus, 1758).

Genus OOCHORISTICA Lühe, 1898.

Generic diagnosis.—Dipylidiinæ: Scolex unarmed, without rostellum. A single set of reproductive organs in each segment. Genital pores irregularly alternate. Testicles numerous, surround female glands posteriorly and on the sides. Vas deferens coiled, seminal vesicle absent. Uterus breaks down early and the eggs become inclosed singly in egg capsules. Adults in mammals and reptiles.

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[a] Fuhrmann (1907a, p. 293) would suppress this generic name in favor of *Cladotænia* Cohn, 1901, type-species, *Tænia globifera* Batsch, 1786, a species which (see Fuhrmann, 1906a, p. 220) is considered sufficiently similar to *Tænia solium* to belong in the same genus, but, under the rules of nomenclature, if *Cladotænia globifera* is transferred to *Tænia*, the generic name *Cladotænia* becomes a synonym of *Tænia*, and can not be used as a separate genus so long as the species *globifera* remains in *Tænia*. Cohn (1901b, p. 380) definitely designated *Tænia globifera* as the type of *Cladotænia*, and hence no other species can be taken as the type of this genus. Accordingly, Fuhrmann's proposal to take *Tænia dendritica* Goeze (one of the species originally included both in *Cladotænia* Cohn and *Catenotænia* Janicki) as type of *Cladotænia* Cohn, and to suppress *Catenotænia* Janicki is entirely at variance with article 29 of the International Code of Nomenclature.

Type-species.—Oochoristica tuberculata (Rudolphi, 1819) Lühe, 1898.

Genus PANCERINA[a] Fuhrmann, 1899.

Panceria SONSINO, 1895 (not ANDRES, 1877, sponge).

Generic diagnosis.—Dipylidiinæ: Scolex unarmed, without rostellum. A double set of reproductive organs in each segment. Testicles numerous, in the lateral fields of the segment, absent from the median field. Uteri develop in the lateral fields of the segment but disappear early, the eggs becoming isolated in the parenchyma, situated mostly in the lateral fields, few in the median field. Adults in reptiles.

Type-species.—Pancerina varanii (Stossich, 1895) =*Panceria arenaria* Sonsino, 1895.

Subfamily PARUTERININÆ (emended name).

"*Paruterinæ*".FUHRMANN, 1907.

Subfamily diagnosis.—Hymenolepididæ: Scolex usually armed, rarely without rostellum. A single (double in *Stilesia*, provisionally placed in this subfamily) set of reproductive organs in each segment. Uterus simple or double with a single para-uterine organ or multiple with several para-uterine organs, into which the eggs pass in the final stage of development of the segment. Adults in birds and amphibia (*Stilesia* in mammals).

Type-genus.—Paruterina Fuhrmann, 1906.

Genus PARUTERINA Fuhrmann, 1906.

Generic diagnosis.—Paruterininæ: Rostellum simple, armed with a double crown of hooks. Genital pores unilateral or irregularly alternate. Testicles (20 to 30) surrounding the female glands behind and at the sides. In front of the uterus a longitudinally elongated parenchymatous organ develops into which the eggs pass after the gravid segments become separated from the strobila. Adults in birds.

Type-species.—Paruterina candelabraria (Goeze, 1782) Fuhrmann, 1906.

PARUTERINA CANDELABRARIA (Goeze, 1782) Fuhrmann, 1906.

For description see KRABBE 1869b, p. 333, pl. 10, fig. 265 (*Tænia candelabraria*).—WOLFFHÜGEL, 1900a, pp. 153-164, figs. 85, 87-96 (*Tænia candelabraria*).

Host.—Asio flammeus.

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[a] Fuhrmann (1899f, p. 627; 1901a, p. 758) refers to this genus by this name, which may well be adopted in view of the fact that *Panceria* Sonsino, 1895, is a homonym of at least one earlier genus.

Genus CULCITELLA Fuhrmann, 1906.

Generic diagnosis.—Paruterininæ: Scolex with simple rostellum, armed with a double crown of hooks. Genital pores unilateral or irregularly alternating. Genital canals pass between the longitudinal excretory vessels. Testicles numerous, in a group behind the female glands, in some cases also extending forward along the sides of the latter. A transversely elongated parenchymatous mass or para-uterine organ into which, probably, the eggs finally pass, develops in front of the sac-like transversely elongated uterus. On the pore side of the segment the large usually ventral longitudinal excretory vessel is dorsal in position and the narrow usually dorsal vessel ventral, the position being normal on the other side. Adults in birds.

Type-species.—*Culcitella rapacicola* Fuhrmann, 1906.

Genus RHABDOMETRA Kholodkovski, 1906.

Generic diagnosis.—Paruterininæ: Scolex unarmed, without rostellum. Genital pores irregularly alternate. Testicles (12 to 30 or more) in posterior portion of segment, in a group behind and extending forward along the sides of the female glands. Genital canals pass between the longitudinal excretory vessels. Uterus tubular and elongated longitudinally, or globular, occupying the median line of the segment. A para-uterine organ develops in front of the uterus and extends forward nearly to the anterior border of the segment. Adults in birds.

Type-species.—*Rhabdometra tomica* Kholodkovski, 1906.

RHABDOMETRA NIGROPUNCTATA (Crety, 1890) Fuhrmann, 1908.

For description see CRETY, 1890d, pp. 8–10, figs. 1–3 (*Tænia nigropunctata*).—STILES, 1896f, p. 59, pl. 20, figs. 268–270 (*T. nigropunctata*).

Host.—*Coturnix coturnix.*

* **RHABDOMETRA NULLICOLLIS** Ransom, 1909.

For description see RANSOM, 1909, pp. 25–30, figs. 15–22 (the present paper).

Hosts.—* *Centrocercus urophasianus*, **Pedioecetes phasianellus columbianus.*

* **RHABDOMETRA SIMILIS**, Ransom, 1909.

For description see RANSOM, 1909, pp. 30–34, figs. 23–26 (the present paper).

Host.—* *Coccyzus americanus.*

Genus ANONCHOTÆNIA Cohn, 1900.

Anurina FUHRMANN, 1901.
Amerina FUHRMANN, 1901.

Generic diagnosis.—Paruterininæ: Scolex unarmed, without rostellum. Genital pores irregularly (typical) or regularly alternate. Genital canals pass ventral of longitudinal excretory vessels and nerve. Testicles few (5 to 10) or more numerous (15 or more), dorsal of female glands and toward anterior border of segment. Ovary and yolk gland, small, ovoid in shape, in middle of segment. Uterus simple, sac-like, median, or displaced toward side of segment opposite genital pore, its antero-posterior axis assuming a diagonal and sometimes a transverse position. In front of or lateral of uterus a para-uterine organ develops into which the eggs finally pass. Adults in birds.

Type-species.—Anonchotænia clava[a] Cohn, 1900 = *Anonchotænia globata* (Linstow, 1879).

***ANONCHOTÆNIA GLOBATA (Linstow, 1879) Fuhrmann, 1908.**

For description see COHN, 1901b, pp. 392–399, pl. 33, figs. 66–68; pl. 34, figs. 69–73 (*A. clava*).—CERRUTI, 1901a, pp. 1–6, figs. 1–11 (*Amerina alaudæ*).—FUHRMANN, 1908c, pp. 623–626, figs. 1–7l.—RANSOM, 1909, pp. 34–36, fig. 27 (the present paper).

*Hosts.—Alauda arvensis, *Dendroica striata, *Melospiza melodia, Passer domesticus, Passer montanus, Ægiothus linaria, Loxia curvirostra.*

ANONCHOTÆNIA LONGIOVATA (Fuhrmann, 1901) Fuhrmann, 1908.

For description see FUHRMANN, 1908c, pp. 627–629, figs. 8–11.

Host.—?Plegadis guarauna.

ANONCHOTÆNIA MACROCEPHALA Fuhrmann, 1908.

For description see FUHRMANN, 1908c, p. 629, fig. 13.

Host.—Progne subis.

ANONCHOTÆNIA, species.

Mentioned by Fuhrmann, 1908a, p. 188; 1908c, p. 631.
Host.—Tyrannus melancholicus.

Genus METROLIASTHES Ransom, 1900.

Generic diagnosis.—Paruterininæ: Scolex unarmed, without rostellum. Genital pores irregularly alternate. Genital canals pass between dorsal and ventral longitudinal excretory vessels and dorsal of the nerve. Testicles rather numerous (20 to 40), in posterior portion of segment. Uterus single in origin and consisting, when fully developed, of two spherical sacs touching in the median line and more or less fused with one another. A para-uterine organ, developing in front of the uterus, and into which the eggs pass, becomes transformed finally into a spherical egg capsule. Adults in birds.

Type-species.—Metroliasthes lucida Ransom, 1900.

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[a] Fuhrmann (1908a, p. 70; 1908c, p. 623) has shown that *Anonchotænia clava* is identical with *Tænia globata* Linstow, 1879, hence *Anonchotænia globata* is the correct name of this species.

*** METROLIASTHES LUCIDA Ransom, 1900.**

For description see RANSOM, 1900a, pp. 213–226, pl. 13, 14; 1905b, pp. 273–274, figs. 2, 9, 21, 27.

Hosts.—* *Meleagris gallopavo domestica,* * *Gallus gallus domesticus?*[a]

Genus BIUTERINA Fuhrmann, 1902.

Generic diagnosis.—Paruterininæ: Rostellum armed with a double crown of hooks triangular in shape, i. e., with short dorsal and ventral roots. Genital pores irregularly alternate. Genital canals pass between the longitudinal excretory vessels. Uterus single in origin becomes more or less completely divided into two parts in front of which a para-uterine organ develops. The latter is transformed into an egg capsule after the passage of the eggs into it from the uteri. Eggs with two envelopes. Adults in birds.

Type-species.—*Biuterina paradisea* Fuhrmann, 1902 = *Biuterina clavulus*[b] (Linstow, 1888).

BIUTERINA LONGICEPS (Rudolphi, 1819) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 337–338, pl. 10, figs. 277, 278 (*Tænia longiceps*).—FUHRMANN, 1908d, pp. 424–425, figs. 22, 23.

Host.—*?Cairina moschata.*

BIUTERINA PASSERINA Fuhrmann, 1908.

For description see CLERC, 1906b, pp. 721–722, figs. 19, 20 (*Biuterina meropina*).—FUHRMANN, 1908d, pp, 426–428, figs. 28–31.

Host.—*Alauda arvensis.*

BIUTERINA TRAPEZOIDES Fuhrmann, 1908.

For description see FUHRMANN, 1908d, pp. 420–421, figs. 12–14.

Host.— *Molothrus ater.*

Genus NEMATOTÆNIA Lühe, 1899.

Generic diagnosis.—Paruterininæ: Scolex unarmed, without rostellum. Segmentation of strobila distinct only at the posterior end. Strobila circular in cross section. Genital pores alternate. Genital canals pass dorsal of the longitudinal excretory vessels and nerve. Uterus horseshoe-shaped, disappears early. Eggs through the action of numerous para-uterine organs become inclosed in egg capsules, 3 or 4 in each capsule. Adults in amphibia.

Type-species.— *Tænia dispar* Goeze, 1782.

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[a] A specimen in the collection of the Bureau of Animal Industry is recorded as collected from a chicken, but it is very probable that a mistake in labeling has been made in this case.

[b] Fuhrmann (1908a, p. 68; 1908d, p. 414) has found that *Biuterina paradisea* is identical with *Tænia clavulus* Linstow, 1888. Hence, the correct name of this species is *Biuterina clavulus.*

Genus STILESIA Railliet, 1893.

Generic diagnosis.—(?) Paruterininæ: Head unarmed, without rostellum. Neck present. Segments broader than long. A double set of reproductive organs in each segment, with opposite pores, or with irregularly alternating pores, those of one side, with the corresponding cirrus pouch, vagina and ovary having been suppressed, both of which conditions may occur in the same strobila. Genital canals pass between the longitudinal excretory vessels and dorsal of the nerve. Dorsal excretory vessel a considerable distance mediad from the ventral vessel. Testicles relatively few (6 to 12 in each set) in the lateral portions of the segment in the neighborhood of the longitudinal excretory vessels. Ovary small, globose, between the dorsal and ventral excretory vessel on pore side of segment. Yolk gland not apparent. Uterus small, spherical, sac-like, one in each lateral half of the segment between the dorsal and ventral excretory vessels. When the ovary is absent from one side, eggs from the opposite side of the segment appear to pass across through the median field in a manner not understood and enter the uterus of the side in which the ovary is lacking. Immediately anterior and mediad of each uterus a para-uterine organ develops into which the eggs probably pass. Eggs with two envelopes. Adults in mammals (ruminants).

Type-species.—*Stilesia globipunctata* (Rivolta, 1874) Railliet, 1893.

Subfamily HYMENOLEPIDINÆ (emended name).

Hymenolepinæ PERRIER, 1897.

Family diagnosis.—Hymenolepididæ: Rostellum armed with a single crown of hooks, or more rarely rudimentary and unarmed. Segments always broader than long. Longitudinal muscles in two layers. A single set of reproductive organs in each segment. Genital pores unilateral. Genital canals pass on the dorsal side of the longitudinal excretory vessels and nerve. Testicles one to four. Vas deferens always short with seminal vesicle. Uterus persistent, saclike. Egg with three transparent shells. Adults in mammals and birds.

Type-genus.—*Hymenolepis* Weinland, 1858.

Genus OLIGORCHIS Fuhrmann, 1906.

Generic diagnosis.—Hymenolepidinæ: Rostellum armed with a single crown of hooks, four testicles in each segment. Seminal vesicle and seminal receptacle large. Adults in birds.

Type-species.—*Oligorchis strangulatus* FUHRMANN, 1906.

OLIGORCHIS STRANGULATUS Fuhrmann, 1906.

For description see FUHRMANN, 1906a, pp. 217–218, figs. 26–30.

Host.—*Elanoides forficatus.*

Genus HYMENOLEPIS Weinland, 1858.

Diplacanthus WEINLAND, 1858 (not AGASSIZ 1842, fish).
Lepidotrias WEINLAND, 1858.
Drepanidotænia RAILLIET, 1892.
Dicranotænia RAILLIET, 1892.
Echinocotyle BLANCHARD, 1891.
Triorchis CLERC, 1903 (1903, p. 286).

Generic diagnosis.—Hymenolepidinæ: Rostellum generally well developed and armed with a single crown of hooks, or more rarely rudimentary and unarmed. Suckers in adult rarely armed with hooklets or fine spines; are generally unarmed. Testicles three in each segment. Vas deferens with internal (i. e., inside the cirrus pouch) as well as external seminal vesicle (outside the cirrus pouch). Sacculus accessorius generally absent. Adults in mammals and birds.

Type-species.—*Hymenolepis flavopunctata* Weinland, 1858 = *Hymenolepis diminuta* (Rudolphi, 1819) Blanchard, 1891.

Subgenus HYMENOLEPIS Weinland, 1858.

Subgeneric diagnosis.—*Hymenolepis:* Rostellum generally well developed and armed with a single crown of hooks, or more rarely rudimentary and unarmed. Suckers in adult generally unarmed, or, rarely, their entire surface may be covered with minute spines. Sacculus accessorius generally absent. Adults in mammals and birds.

Type-species.—*Hymenolepis flavopunctata* Weinland, 1858 = *Hymenolepis diminuta* (Rudolphi, 1819) Blanchard, 1891.

HYMENOLEPIS ABORTIVA Linstow, 1904.

For description see LINSTOW, 1904m, pp. 382–383, figs. 7–10 (*Tænia* (*Hymenolepis*) *voluta*).[a]

Host.—*Anas platyrhynchos.*

HYMENOLEPIS ÆQUABILIS (Rudolphi, 1810) Cohn, 1901.

For description see KRABBE, 1869b, pp. 316–317, pl. 8, figs. 212, 213 (*Tænia æquabilis*).—STILES, 1896f, pp. 33–34, pl. 3, figs. 29, 30 (*Dicranotænia æquabilis*).—CLERC, 1903, pp. 290–293, pl. 8, figs. 2, 16, 24 (*Drepanidotænia æquabilis*).

Hosts.—*Marila marila, Cygnus olor, Cygnus olor domesticus, Olor cygnus.*

HYMENOLEPIS AMPHITRICHA (Rudolphi, 1819) Fuhrmann, 1906.

For description see KRABBE, 1869b, pp. 311–312, pl. 8, figs. 195–197 (*Tænia amphitricha*).—CLERC, 1903, pp. 293–295, pl. 8, fig. 21 (*Drepanidotænia amphitricha*).

Hosts.—*Totanus totanus, Pelidna alpina, Arquatella maritima, Scolopax rusticola.*

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[a] Corrected to *Tænia* (*Hymenolepis*) *abortiva*, Centralbl. f. Bak., vol. 36, p. 592.

HYMENOLEPIS ANATINA (Krabbe, 1869) Cohn, 1901.
For description see KRABBE, 1869b, pp. 287-288, pl. 6, figs. 114-116 (*Tænia anatina*).—SCHMIDT, 1894a, pp. 65-112, pl. 6 (*Tænia anatina*).—STILES, 1896f, pp. 39-40, pl. 9, figs. 100-111; pl. 10, figs. 112-115 (*Drepanidotænia anatina*).—COHN, 1901b, pp. 322-323.

Hosts.—Spatula clypeata, Dafila acuta, Chaulelasmus streperus, Anas platyrhynchos, Anas platyrhynchos domestica, Cygnus olor domesticus, Fulica atra.

HYMENOLEPIS ARCUATA Kowalewski, 1904.
For description see KOWALEWSKI, 1905a, pp. 3-9, pl. 7, figs. 1-9; 1905b, pp. 532-533, pl. 14, figs. 1-9.

Host.— Marila marila.

HYMENOLEPIS ARDEÆ [a] **Fuhrmann, 1906.**
For description see FUHRMANN, 1906b, pp. 451-452, figs. 37-39.

Host.—Butorides virescens.

HYMENOLEPIS BASCHKIRIENSIS (Clerc, 1902) Fuhrmann, 1906.
For description see CLERC, 1903, pp. 288-290 (*Drepanidotænia baschkiriensis*).

Host.—Larus canus.

HYMENOLEPIS BISACCATA Fuhrmann, 1906.
For description see FUHRMANN, 1906b, pp. 444-445, figs. 21-24.

Host.—Cairina moschata.

HYMENOLEPIS BRACHYCEPHALA (Creplin, 1829).
For description see KRABBE, 1869b, pp. 294-295, pl. 6, figs. 136-140 (*Tænia brachycephala*).—COHN, 1901b, pp. 280-284, pl. 29, figs. 13, 14.

Host.— Machetes pugnax.

HYMENOLEPIS BRASILIENSIS Fuhrmann, 1906.
For description see FUHRMANN, 1906b, p. 446, fig. 26.

Host.—Antrostomus carolinensis.

* **HYMENOLEPIS CANTANIANA (Polonio, 1860) Ransom, 1909.**
For description see RANSOM, 1909, pp. 36-41, figs. 28, 29 (the present paper).

*Hosts.— Meleagris gallopavo domestica, *Pavo cristatus, *Gallus gallus domesticus, Phasianus colchicus.*

HYMENOLEPIS CAPILLARIS (Rudolphi, 1810) Fuhrmann, 1906.
For description see KRABBE, 1869b, p. 307, pl. 7, fig. 179 (*Tænia capillaris*).

Hosts.—Gavia stellata, Gavia arctica, Gavia immer, Colymbus auritus.

HYMENOLEPIS CAPILLAROIDES Fuhrmann, 1906.
For description see FUHRMANN, 1906b, pp. 355-356, figs. 6, 7.

Host.—Colymbus dominicus.

* **HYMENOLEPIS CARIOCA (Magalhaes, 1898) Ransom, 1902.**
For description see RANSOM, 1902a, pp. 151-158, pl. 23, figs. 1-7; pl. 24, figs. 8-10; 1905b, pp. 274-276, figs. 3, 10, 22, 28.

*Host.—*Gallus gallus domesticus.*

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[a] See discussion under *Dilepis unilateralis* (p. 72).

HYMENOLEPIS CLANDESTINA (Creplin in Krabbe, 1869) Cohn, 1904.

For description see KRABBE, 1869b, p. 316, pl. 8, figs. 208, 209 (*Tænia clandestina*).—COHN, 1904, pp. 243–246, pl. 11, figs. 9–12.

Host.—Hæmatopus ostralegus.

HYMENOLEPIS COLLARIS (Batsch, 1786) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 298–299, pl. 7, figs. 151–153 (*Tænia sinuosa*).—STILES, 1896f, pp. 40–41, pl. 10, figs. 116–124; pl. 11, figs. 125–139; pl. 12, figs. 140–146; pl. 13, fig. 153 (*Drepanidotænia sinuosa*).—COHN, 1901b, pp. 323–325 (*Hymenolepis sinuosa*).

Hosts.—Dafila acuta, Mareca penelope, Anas platyrhynchos, Anas platyrhynchos domestica, Anser anser, Anser anser domesticus.

HYMENOLEPIS COMPRESSA (Linton, 1892) Fuhrmann, 1906.

For description see LINTON, 1892l, pp. 108–110, pl. 8, figs. 83-92 (*Tænia compressa*).—KOWALEWSKI, 1907, p. 775, pl. 23, figs. 7-11; 1908, pp. 638–641; pl. 20, figs. 7-11.

Hosts.—Oidemia americana, Aristonetta valisineria, Marila marila.

HYMENOLEPIS CORONULA (Dujardin, 1845) Cohn, 1901.

For description see KRABBE, 1869b, pp. 317–318, pl. 8, figs. 216–219 (*Tænia coronula*).—STILES, 1896f, p. 33, pl. 3, figs. 21-28 (*Dicranotænia coronula*).—WOLFFHÜGEL, 1900a, pp. 165–175, figs. 97–105 (*Dicranotænia coronula*).—LINSTOW, 1905dd, p. 5, pl. 1, figs. 16–18 (*H. megalhystera*).

Hosts.—Harelda hyemalis, Clangula clangula, Marila marila, Mareca penelope, Anas platyrhynchos, Anas platyrhynchos domestica, Anser anser.

HYMENOLEPIS CREPLINI (Krabbe, 1869).

For description see KRABBE, 1869b, p. 317, pl. 8, figs. 214, 215, (*Tænia creplini*).—COHN, 1901b, pp. 304–307, pl. 30, figs. 31–33.

Hosts.—Anser anser, Anser albifrons, Cygnus olor, Olor cygnus.

HYMENOLEPIS ECHINOCOTYLE Fuhrmann, 1907.

For description see FUHRMANN, 1907b, pp. 532–533, figs. 37, 38.

Host.—Spatula clypeata.

HYMENOLEPIS EXILIS[a] (Dujardin, 1845) Fuhrmann, 1906.

For description see DUJARDIN, 1845a, p. 602 (*Tænia exilis*).—STILES, 1896f, p. 58 (*Tænia exilis*).

Host.—Gallus gallus domesticus.

HYMENOLEPIS FALLAX (Krabbe, 1869) Cohn, 1901.

For description see KRABBE, 1869b, p. 319, pl. 8, figs. 221, 222 (*Tænia fallax*).

Hosts.—Somateria mollissima, Marila marila, Mareca penelope.

HYMENOLEPIS FARCIMINOSA (Goeze, 1782).

For description see KRABBE, 1869b, pp. 321-322, pl. 9, figs. 230–232 (*Tænia farciminalis*).—VOLZ, 1900, pp. 32–35, pl. 2, fig. 10 (*Diplacanthus farciminalis*)

Host.—Sturnus vulgaris.

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[a] This species is perhaps identical with *Hymenolepis carioca*, but the original description is so incomplete that this question can not be settled.

HYMENOLEPIS FASCICULATA, new name.[a]

For description see KRABBE, 1869b, p. 300, pl. 7, figs. 156, 157 (*Tænia fasciata*).—STILES, 1896f, pp. 37–38, pl. 5, figs. 56–66; pl. 6, figs. 67–76; pl. 7, figs. 77–79 (*Drepanidotænia fasciata*).—COHN, 1901b, p. 329.—CLERC, 1903, p. 307 (*Drepanidotænia fasciata*).

Hosts.—Mareca penelope, Anser anser, Anser anser domesticus, Anser albifrons.

HYMENOLEPIS FRAGILIS (Krabbe, 1869) Fuhrmann, 1906.

For description see KRABBE, 1869b, pp. 300–301, pl. 7, figs. 158–160 (*Tænia fragilis*).—FUHRMANN, 1906b, pp. 747–748, figs. 11–12.

Hosts.—Nettion crecca, Chaulelasmus streperus.

HYMENOLEPIS PASSERIS (Gmelin, 1790).

For description see KRABBE, 1869b, pp. 326–327, pl. 9, figs. 245–247 (*Tænia fringillarum*).

Hosts.—Passer domesticus, Passer montanus, Ægiothus linaria.

HYMENOLEPIS FURCIFERA (Krabbe, 1869).

For description see KRABBE, 1869b, p. 306, pl. 7, figs. 176–178 (*Tænia furcifera*).—SZYMANSKI, 1904a, p. 344, pl. 8, figs. 6, 7 (*Tænia furcifera*); 1905b, p. 734, pl. 16, figs. 6, 7 (*Tænia furcifera*).—LINSTOW, 1908, pp. 38–39, figs. 1, 2.

Host.—Colymbus auritus.

HYMENOLEPIS FUSUS (Krabbe, 1869) Fuhrmann, 1906.

For description see KRABBE, 1869b, pp. 307–308, pl. 7, figs. 180, 181 (*Tænia fusus*).

Hosts.—Larus hyperboreus, Larus marinus.

HYMENOLEPIS GRACILIS (Zeder, 1803) Cohn, 1901.

For description see KRABBE, 1869b, p. 299, pl. 7, figs. 154, 155 (*Tænia gracilis*).—STILES, 1896f, pp. 38–39, pl. 7, figs. 80–91; pl. 8, figs. 92–99 (*Drepanidotænia gracilis*).—WOLFFHÜGEL, 1900a, pp. 176–183, figs. 106–109 (*Drep. gracilis*).—COHN, 1901b, pp. 327–329.—CLERC, 1903, pp. 305–306 (*Drep. gracilis*).

Hosts.—Mergus serrator, Marila marila, Spatula clypeata, Nettion crecca, Mareca penelope, Chaulelasmus streperus, Anas platyrhynchos, Anas platyrhynchos domestica, Anser anser domesticus.

HYMENOLEPIS GRŒNLANDICA (Krabbe, 1869) Fuhrmann, 1906.

For description see KRABBE, 1869b, p. 316, pl. 8, figs. 210, 211 (*Tænia grœnlandica*).

Host.—Harelda hyemalis.

HYMENOLEPIS HIMANTOPODIS (Krabbe, 1869) Fuhrmann, 1906.

For description see KRABBE, 1869b, pp. 309–310, pl. 8, fig. 190 (*Tænia himantopodis*).—FUHRMANN, 1906b, pp. 748–749, fig. 13.

Host.—Himantopus mexicanus.

HYMENOLEPIS INTERRUPTA (Rudolphi, 1802) Fuhrmann, 1906.

For description see FUHRMANN, 1906b, pp. 745–746, fig. 8.

Host.—Scolopax rusticola.

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[a] New name for *Tænia fasciata* Rudolphi of Krabbe, 1869. *Tænia fasciata* Rudolphi, 1810=*Tænia setigera* Frölich, 1789.

HYMENOLEPIS LANCEOLATA (Bloch, 1782) Weinland, 1858.
For description see Stiles, 1896f, pp. 36–37, pl. 4, figs. 43–53; pl. 5, figs. 54, 55 (*Drepanidotænia lanceolata*).—Clerc, 1903, pp. 302–303, pl. 8, fig. 4 (*Drep. lanceolata*).—Ransom, 1904d, pp. 14, 101–110, figs. 108–130.

Hosts.—Netta rufina, Cairina moschata, Anas rubripes, Anas platyrhynchos domestica, Branta bernicla, Anser anser, Anser anser domesticus, Olor cygnus.

HYMENOLEPIS LINEA (Goeze, 1782) Wolffhügel, 1899.
For description see Krabbe, 1869b, pp. 327–328, pl. 9, figs. 248, 249 (*Tænia linea*).—Wolffhügel, 1900a, pp. 189–190, pl. 7, fig. 112.

Host.—Coturnix coturnix.

HYMENOLEPIS LIOPHALLOS (Krabbe, 1869) Fuhrmann, 1906.
For description see Krabbe, 1869b, p. 291, pl. 6, fig. 122 (*Tænia liophallos*).

Host.—Olor cygnus.

HYMENOLEPIS LONGIVAGINATA Fuhrmann, 1906.
For description see Fuhrmann, 1906b, pp. 752–753, fig. 19.

Host.—Branta leucopsis.

HYMENOLEPIS MACRACANTHOS (Linstow, 1877) Fuhrmann, 1906.
For description see Linstow, 1877a, pp. 16–17, pl. 1, fig. 24 (*Tænia macracanthos*).

Host.—Clangula clangula.

* **HYMENOLEPIS MEGALOPS** (Nitzsch in Creplin, 1829) Parona, 1899.
For description see Ransom, 1902a, pp. 158–167, pl. 24, figs. 11–14; pl. 25, figs. 15–20.

*Hosts.—Marila marila, Cairina moschata, Nettion crecca, *Dafila acuta, Anas platyrhynchos domestica, Olor cygnus.*

HYMENOLEPIS MELEAGRIS (Clerc, 1902) Fuhrmann, 1906.
For description see Clerc, 1902a, pp. 574–575 (*Drepanidotænia meleagris*); 1903, p. 306 (un Cestode dans *Meleagris gallopavo*).

Host.—Meleagris gallopavo domestica.

HYMENOLEPIS MICRANCRISTROTA (Wedl, 1856) Fuhrmann, 1906.
For description see Krabbe, 1869b, p. 318, pl. 8, fig. 220 (*Tænia micrancristrota*).

Host.—Olor cygnus.

HYMENOLEPIS MICROCEPHALA (Rudolphi, 1819) Fuhrmann, 1906.
For description see Krabbe, 1869b, p. 310, pl. 8, figs. 191, 192 (*Tænia microcephala*).—Cohn, 1904, pp. 246–248, pl. 11, figs. 13-16 (*Tænia multiformis*).

Host.—Nycticorax nycticorax, Ardea cinerea, Plegadis autumnalis.

HYMENOLEPIS MICROPS (Diesing, 1850) Fuhrmann, 1906.
For description see Wolffhügel, 1900a, pp. 191–192, fig. 110 (*H. tetraonis*).

Host.—Centrocercus urophasianus?[a]

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[a] Leidy (1887a, p. 1) identified tapeworms from this host as *Tænia microps* Diesing, but according to Fuhrmann (1908a, p. 103) they are probably a species of *Davainea*.

HYMENOLEPIS MICROSOMA (Creplin, 1829) Cohn, 1901.
For description see KRABBE, 1869b, pp. 296–298, pl. 6, figs. 146–150 (*Tænia microsoma*).—COHN, 1901b, pp. 284-288, pl. 29, figs. 15–22.

Hosts.—Oidemia fusca, Somateria spectabilis, Somateria mollissima, Harelda hyemalis, Marila marila, ? Larus hyperboreus.

HYMENOLEPIS MINOR, new name.[a]
For description see KRABBE, 1869b, p. 292, pl. 6, figs. 127–129 (*Tænia minuta*).

Host.—Lobipes lobatus.

HYMENOLEPIS MUSCULOSA (Clerc, 1902) Fuhrmann, 1906.
For description see CLERC, 1903, pp. 303–305, pl. 8, figs. 17, 23; pl. 9, figs. 29, 35 (*Drepanidotænia musculosa*).

Host.—Meleagris gallopavo domestica.

HYMENOLEPIS OCTACANTHA (Krabbe, 1869) Fuhrmann, 1906, not Cohn, 1901.
For description see KRABBE, 1869b, p. 301, pl. 7, figs. 161, 162 (*Tænia octacantha*).—FUHRMANN, 1906b, pp. 746–747, figs. 9, 10.

Hosts.—Spatula clypeata, Nettion crecca, Dafila acuta, Chaulelasmus streperus, Anas platyrhynchos.

HYMENOLEPIS ORIENTALIS (Krabbe, 1879) Fuhrmann, 1906.
For description see KRABBE, 1879a, p. 11, figs. 50–52 (*Tænia orientalis*); 1882a, p. 360, pl. 2, figs. 43, 44 (*T. orientalis*).

Host.—Saxicola œnanthe.

HYMENOLEPIS PACHYCEPHALA (Linstow, 1872) Fuhrmann, 1906.
For description see LINSTOW, 1872d, p. 55, pl. 3, figs. 2–4 (*Tænia pachycephala*); 1904n, p. 305, pl. 13, figs. 17–20 (*Drepanidotænia pachycephala*).

Host.—Colymbus auritus, Histrionicus histrionicus.

HYMENOLEPIS PAPILLATA Fuhrmann, 1906.
For description see FUHRMANN, 1906b, pp. 357–358, figs. 10, 11.

Host.—Cairina moschata.

HYMENOLEPIS PARVULA Kowalewski, 1904.
For description see KOWALEWSKI, 1905a, pp. 9–16, pl. 7, figs. 10–17; 1905b, pp. 533–534, pl. 14, figs. 10–17.

Host.—Anas platyrhynchos domestica.

HYMENOLEPIS PHASIANINA Fuhrmann, 1907.
For description see FUHRMANN, 1907b, pp. 533–534, figs. 40, 41.

Host.—Phasianus colchicus.

HYMENOLEPIS PIGMENTATA (Linstow, 1872) Fuhrmann, 1906.
For description see LINSTOW, 1872d, p. 56, pl. 3, figs. 7, 8 (*Tænia pigmentata*).

Host.—Marila marila.

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[a] New name for *Tænia minuta* Krabbe, 1869, not *Tænia minuta* Braun in Rudolphi, 1810.

HYMENOLEPIS POCULIFERA (Linstow, 1879) Fuhrmann, 1906.

For description see Linstow, 1879a, pp. 186–187, pl. 12, figs. 37, 38 (*Tænia poculifera*).

Host.—Fulica atra.

HYMENOLEPIS PODICIPINA Szymanski, 1904.

For description see Szymanski, 1904a, pp. 342–344, pl. 8, figs. 1–5; 1905b, pp. 733–734, pl. 16, figs. 1–5.

Host.—Colymbus auritus.

HYMENOLEPIS RECTACANTHA Fuhrmann, 1906.

For description see Fuhrmann, 1906b, pp. 446–447, fig. 27.

Host.—Ægialitis hiaticula.

HYMENOLEPIS RETRACTA Linstow, 1905.

For description see Linstow, 1905dd, p. 4, pl. 1, fig. 15.

Host.—Somateria spectabilis.

HYMENOLEPIS ROSTELLATA (Abildgaard, 1790) Fuhrmann, 1908.

For description see Krabbe, 1869b, pp. 286–287, pl. 5, figs. 112, 113 (*Tænia capitellata*).—Fuhrmann, 1896k, pp. 443–449, pl. 14, figs. 5–10 (*Tænia capitellata*).

Hosts.—Gavia stellata, Gavia arctica, Gavia immer.

HYMENOLEPIS RUGOSA Clerc, 1906.

For description see Clerc, 1906a, pp. 433–434, figs. 1–4.

Host.—Columba livia.

HYMENOLEPIS SAGITTA (Rosseter, 1906) Fuhrmann, 1908.

For description see Rosseter, 1906b, pp. 275–278, 1 pl. (*Drepanidotænia sagitta*).

Host.—Anas platyrhynchos domestica.

HYMENOLEPIS SERPENTULUS (Schrank, 1788) Weinland, 1858.

For description see Volz, 1900, pp. 135–140, pl. 7, fig. 8 (*Diplacanthus serpentulus*).—Cohn, 1901b, pp. 294–297, pl. 29, figs. 23, 24; pl. 30, fig. 25, 1 text figure.—Clerc, 1903, pp. 295–296, pl. 8, fig. 8 (*Drepanidotænia serpentulus*).

Hosts.—?Planesticus migratorius, Pica pica, Corvus corax.

HYMENOLEPIS SETIGERA (Frölich, 1789) Cohn, 1901.

For description see Krabbe, 1869b, pp. 289–290, pl. 6, figs. 117–121 (*Tænia setigera*).—Stiles, 1896f, pp. 41–42, pl. 12, figs. 147–150; pl. 13, figs. 154–164 (*Drepanidotænia setigera*).—Clerc, 1903, pp. 298–302, pl. 8, figs. 3, 6, 7, 12, 22 (*Drepanidotænia setigera*).

Hosts.—Branta bernicla, Branta leucopsis, Anser anser, Anser fabalis, Cygnus olor domesticus, Olor cygnus.

HYMENOLEPIS SIBIRICA (Linstow, 1905) Fuhrmann, 1908.

For description see Linstow, 1905dd, pp. 6–7, pl. 1, fig. 22 (*Diorchis sibirica*).

Host.—Somateria spectabilis.

HYMENOLEPIS SPHÆROPHORA (Rudolphi, 1810) Fuhrmann, 1906.

For description see Rudolphi, 1810a, pp. 119–120 (*Tænia sphærophora*).—Cobbold, 1858b, p. 164, pl. 33, figs. 63–67 (*T. sphærophora*).

Hosts.—Gallinago gallinago, Scolopax rusticola.

HYMENOLEPIS COLUMBÆ (Zeder, 1800).
For description see FUHRMANN, 1906b, pp. 449–450, figs. 34, 35 (*H. sphenocephala*).

Host.—Columba livia domestica.

HYMENOLEPIS STYLOSA (Rudolphi, 1810) Volz, 1899.
For description see KRABBE, 1869b, p. 326, pl. 9, figs. 242–244 (*Tænia stylosa*).—VOLZ, 1900, pp. 141–144, pl. 7, fig. 9 (*Diplacanthus stylosus*).

Hosts.—Pica pica, Corvus corax.

HYMENOLEPIS TENERRIMA (Linstow, 1882) Fuhrmann, 1906.
For description see LINSTOW, 1882a, p. 21, pl. 2, fig. 26 (*Tænia tenerrima*).

Host.—Marila marila.

HYMENOLEPIS TENUIROSTRIS (Rudolphi, 1819) Cohn, 1901.
For description see KRABBE, 1869b, pp. 291–292, pl. 6, figs. 123–126 (*Tænia tenuirostris*).—STILES, 1896f, p. 43, pl. 14, figs. 165–172 (*Drepanidotænia tenuirostris*).—COHN, 1901b, pp. 326–327.

Hosts.—Mergus serrator, Mergellus albellus, Oidemia fusca, Somateria mollissima, Marila marila, Anas platyrhynchos domestica, Anser anser domesticus.

HYMENOLEPIS TERESOIDES Fuhrmann, 1906.
For description see FUHRMANN, 1906b, pp. 443–444, fig. 20.

Host.—Chaulelasmus streperus.

HYMENOLEPIS TRIFOLIUM Linstow, 1906.
For description see LINSTOW, 1905t, pp. 361–362, pl. 23, figs. 6, 7.

Host.—Anas platyrhynchos.

HYMENOLEPIS ULIGINOSA (Krabbe, 1882) Fuhrmann, 1906.
For description see KRABBE, 1882a, p. 355, pl. 1, figs. 25–27 (*Tænia uliginosa*).

Host.—Numenius phæopus.

HYMENOLEPIS VALLEI (Stossich, 1892) Fuhrmann, 1906.
For description see STOSSICH, 1892b, pp. 68–69, pl. 1, figs. 3, 4 (*Tænia vallei*).

Host.—?Pisobia damacensis.

HYMENOLEPIS VENUSTA (Rosseter, 1897).
For description see ROSSETER, 1898a, pp. 10–23, pls. 1, 2, figs. 1–17 (*Drepanidotænia venusta*).

Host.—Anas platyrhynchos domestica.

HYMENOLEPIS VILLOSA (Bloch, 1782) Wolffhügel, 1899.
For description see KRABBE, 1869b, pp. 303–304, pl. 7, figs. 168, 169 (*Tænia villosa*); 1882a, pp. 354–355, pl. 1, figs. 19–22 (*Tænia villosa*).—WOLFFHÜGEL, 1900a, pp. 184–188, pl. 7, fig. 11.

Host.—?Gallus gallus domesticus.

HYMENOLEPIS, species Cohn.
For description see COHN, 1901b, pp. 312–319, pl. 31, figs. 38, 39.

Host.—Marila marila.

Subgenus ECHINOCOTYLE Blanchard, 1891.

Subgeneric diagnosis.—Hymenolepis: Rostellum armed with a single crown of ten slender hooks with dorsal root and blade about equal in length and ventral root rudimentary. Suckers large, flat, armed on the borders and in the middle with small hooklets. A sacculus accessorius always present. Adults in birds.

Type-species.—Echinocotyle rosseteri Blanchard, 1891.

ECHINOCOTYLE NITIDA (Krabbe, 1869) Clerc, 1902.

For description see Krabbe, 1869b, p. 294, pl. 6, figs. 133–135 (*Tænia nitida*).—Clerc, 1903, pp. 310–315, pl. 9, figs. 26, 27, 30, 31, 36, 38, 40–42.

Hosts.—Limosa limosa, Pisobia damacensis, Pelidna alpina, Arquatella maritima, Gallinago gallinago.

ECHINOCOTYLE NITIDULANS (Krabbe, 1882) Fuhrmann, 1906.

For description see Krabbe, 1882a, p. 353, pl. 1, figs. 16, 17 (*Tænia nitidulans*).

Hosts.—Ægialitis hiaticula, Pelidna alpina.

ECHINOCOTYLE ROSSETERI Blanchard, 1891.

For description see Blanchard, 1891t, pp. 424–428, figs. 1–3.—Stiles, 1896f, pp. 55–56, pl. 19, figs. 247–251.

Host.—Anas platyrhynchos domestica.

Genus DIORCHIS Clerc, 1903.

Generic diagnosis.—Hymenolepidinæ: Rostellum with a single crown of ten hooks with long dorsal and short ventral roots or exceptionally with very short dorsal root and with ventral root nearly as long as the blade. Surface of suckers may be armed with minute spines. Inner longitudinal muscle layer consisting of 8 bundles, 4 dorsal and 4 ventral. Two testicles in each segment. Adults in birds.

Type-species.—Diorchis acuminata (Clerc, 1902) Clerc, 1903.

*** DIORCHIS ACUMINATA (Clerc, 1902) Clerc, 1903.**

For description see Clerc, 1903, pp. 281–284, pl. 9, fig. 25; pl. 11, figs. 78, 88.—Ransom, 1909, pp. 42–48, figs. 30–36 (the present paper).

*Hosts.—Nettion crecca, Mareca penelope, Chaulelasmus streperus, Fulica atra, *Fulica americana.*

*** DIORCHIS AMERICANA Ransom, 1909.**

For description see Ransom, 1909, pp. 48–51, figs. 37–42 (the present paper).

Host.— Fulica americana.*

DIORCHIS INFLATA (Rudolphi, 1819) Clerc, 1903.

For description see Krabbe, 1869b, pp. 285–286, pl. 5, figs. 109–111 (*Tænia inflata*).—Jacobi, 1898c, pp. 95–104, 1 pl. (*T. inflata*).—Cohn, 1901b, pp. 330–331 (*Hymenolepis inflata*).—Clerc, 1903, pp. 284–288, pl. 11, fig. 89.—Linstow, 1906, pp. 15–17, pl. 1, figs. 17, 18 (*H. inflata*).

Host.—Fulica atra.

DIORCHIS PARVICEPS (Linstow, 1872) Linstow, 1904.

For description see LINSTOW, 1872d, p. 57, pl. 3, figs. 11, 12 (*Tænia parviceps*); 1904n, pp. 306–307, pl. 13, figs. 23–25.

Host.—Mergus serrator.

Genus APLOPARAKSIS Clerc, 1903.

Monorchis CLERC, 1902 (type, *M. filum* (GOEZE, 1782); not *Monorchis*, Trematoda).

Skorikowia LINSTOW, 1905 (type, *S. clausa* LINSTOW, 1905=*Aploparaksis brachyphallos* (KRABBE). (See FUHRMANN, 1908a, p. 82).

Generic diagnosis.—Hymenolepidinæ: Strobila small and slender. Rostellum armed with a single crown of hooks, with ventral root as long or nearly as long as the blade. Suckers unarmed. One testicle, dorsal. Seminal vesicle large. Adults in birds.

Type-species.—Aploparaksis filum (Goeze, 1782) Clerc, 1903.

APLOPARAKSIS BIRULAI Linstow, 1905.

For description see LINSTOW, 1905dd, p. 8, pl. 2, figs. 26–28.

Host.—Somateria spectabilis.

APLOPARAKSIS BRACHYPHALLOS (Krabbe, 1869) Fuhrmann, 1908.

For description see KRABBE, 1869b, pp. 310–311, pl. 8, figs. 193, 194 (*Tænia brachyphallos*).

Hosts.—Aegialitis hiaticula, Calidris leucophæa, Pisobia damacensis, Pelidna alpina, Arquatella maritima, Tringa canutus.

APLOPARAKSIS CIRROSA (Krabbe, 1869) Clerc, 1903.

For description see KRABBE, 1869b, p. 308, pl. 7, figs. 182–185 (*Tænia cirrosa*).—CLERC, 1903, pp. 269–271, pl. 8, fig. 14.

Hosts.—Larus canus, Larus minutus, Sterna hirundo.

APLOPARAKSIS CRASSIROSTRIS (Krabbe, 1869) Clerc, 1903.

For description see KRABBE, 1869b, p. 314, pl. 8, figs. 202–204 (*Tænia crassirostris*).—CLERC, 1903, pp. 265–267, pl. 8, fig. 20.

Hosts.—Hæmatopus ostralegus, Squatarola squatarola, Aegialitis hiaticula, Machetes pugnax, Pisobia damacensis, Pelidna alpina, Gallinago gallinago, Scolopax rusticola, Lobipes lobatus.

APLOPARAKSIS DIMINUENS Linstow, 1905.

For description see LINSTOW, 1905dd, pp. 8–9, pl. 2, figs. 29–31.

Host.—Phalaropus fulicarius.

APLOPARAKSIS DUJARDINII (Krabbe, 1869) Clerc, 1903.

For description see KRABBE, 1869b, pp. 319–320, pl. 9, figs. 223–225 (*Tænia dujardinii*).—FUHRMANN, 1896k, pp. 436–442, pl. 14, figs. 1–4 (*Tænia dujardini*).—CLERC, 1903, pp. 274–275 (*A. dujardini*).

Hosts.—Sturnus vulgaris, Turdus musicus.

APLOPARAKSIS FILUM (Goeze, 1782) Clerc, 1903.

For description see KRABBE, 1869b, pp. 312–313, pl. 8, figs. 198–201 (*Tænia filum*).—CLERC, 1903, pp. 257–263, figs. 1, 2, pl. 8, figs. 11, 15.

Hosts.—Arenaria interpres, Limosa limosa, Totanus totanus, Helodromas ochropus, Machetes pugnax, Pisobia damacensis, Pelidna alpina, Gallinago media, Gallinago gallinago, Scolopax rusticola, Lobipes lobatus.

APLOPARAKSIS FURCIGERA (Rudolphi, 1819) Fuhrmann, 1908.

For description see KRABBE, 1869b, p. 315, pl. 8, figs. 205–207 (*Tænia rhomboidea*).—STILES, 1896f, pp. 34–35, pl. 3, figs. 31–34 (*Dicranotænia furcigera*)

Hosts.—Nettion crecca, Anas platyrhynchos.

APLOPARAKSIS PENETRANS (Clerc, 1902) Clerc, 1903.

For description see CLERC, 1903, pp. 271–274, pl. 8, figs. 10, 18, 19.—KOWALEWSKI, 1907, p. 774, pl. 23, figs. 1–6; 1908, pp. 633–638, pl. 20, figs. 1–6.

Hosts.—Pisobia damacensis, Gallinago gallinago.

APLOPARAKSIS PUBESCENS (Krabbe, 1882).

For description see KRABBE, 1882a, p. 355 (*Tænia pubescens*), pl. 1, figs. 23, 24, pl. 8, figs. 1, 5 (*T. hirsuta*).

Hosts.—Helodromas ochropus, Scolopax rusticola.

Family TÆNIIDÆ Ludwig, 1886.

Family diagnosis.—Tænioidea: Scolex usually with well developed rostellum armed with a double crown of hooks, rarely with rudimentary unarmed rostellum. Suckers unarmed. Gravid segments longer than broad. A single set of reproductive organs in each segment. Genital pores irregularly alternate. Vas deferens coiled, seminal vesicle absent. Testicles numerous, usually very numerous, scattered throughout the medullary parenchyma, except in the posterior median portion occupied by the double ovary, posterior of which is the yolk gland. Uterus with median stem, and when fully developed with lateral branches. Egg with a thin outer membrane, and a thick brown radially striated inner shell. Adults in mammals and birds.

Type-genus.—Tænia Linnæus, 1758.

Genus TÆNIA Linnæus, 1758.

Cladotænia[a] COHN, 1901 (type, *C. globifera* (BATSCH, 1786) = *Tænia cylindracea* BLOCH, 1782; see FUHRMANN, 1906a, p. 220; 1907a, p. 293; 1908a, p. 84).

Generic diagnosis.—Tæniidæ: With the characters of the family. Adults in mammals and birds.

Type-species.—Tænia solium Linnæus, 1758.

TÆNIA CYLINDRACEA Bloch, 1782.

For description see MORELL, 1895b, pp. 87–92, pl. 7, figs. 5–7 (*T. globifera*).—VOLZ, 1900, pp. 157–160, pl. 8, fig. 14 (*T. globifera*); pp. 161–163, pl. 8, figs. 15, 16 (*T. armigera*).—COHN, 1901b, pp. 373–380, pl. 32, figs. 51–53; pl. 33, figs. 55, 56 (*Cladotænia globifera*).

Hosts.—Cerchneis tinnunculus, Falco æsalon, Falco peregrinus, Haliæetus albicilla.

TÆNIA CONSCRIPTA Railliet and Henry, 1909.

For description see KOWALEWSKI, 1895a, p. 359, pl. 8, fig. 27 (*Tænia krabbei*).—STILES, 1896f, pp. 42–43, pl. 12, figs. 151, 152 (*Tænia krabbei*).

Host.—Anser anser domesticus.

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[a] For earlier synonyms of *Tænia*, see Stiles, 1906a, p. 36.

Genus DIPLOPOSTHE Jacobi, 1896.

Generic diagnosis.—Tænioidea: Closely related to the Acoleidæ (according to Fuhrmann, 1907a, p. 294; 1908a, p. 85). Scolex with rostellum armed with a single crown of ten hooks. Suckers unarmed. Inner longitudinal muscle layer, except for two or three small bundles in the lateral portion beyond the excretory vessels, developed only in the median portion of the segment, consisting of about ten dorsal and ten ventral bundles of unequal size. Outer longitudinal muscle layer of numerous equally developed bundles, interrupted only at the sides where the genital canals pass through. Outside the outer longitudinal layer a thin layer of diagonal fibers, and at the posterior end of the segment a well-developed muscle ring. Genital pores marginal, one on each side of the segment. Testicles few (3 to ? 7), in the posterior portion of the segment. Vasa efferentia unite to form two vasa deferentia. Seminal vesicles present. Cirri two, one on each side of the segment, armed with strong hooks. A single set of female glands in the median field. Ovary bilobed; behind it, near the posterior border of the segment, the yolk gland. Two vaginæ. Uterus saclike, transversely elongated, with large diverticula, which push through the musculature dorsally and ventrally, and also extend forward to the anterior border of the segment. Eggs with three thin transparent envelopes. Adults in birds.

Type-species.—*Diploposthe lævis* (Bloch, 1782, of Diesing, 1850) Jacobi, 1896.

DIPLOPOSTHE LÆVIS (Bloch, 1782) Jacobi, 1896.

For description see KRABBE, 1869b, pp. 302–303, pl. 7, figs. 165–167 (*Tænia lævis*).—JACOBI, 1897a, pp. 287–306, pls. 26, 27.—COHN, 1901b, pp. 421–430, pl. 35, figs. 81–85.—FUHRMANN, 1905a, pp. 217–224.

Hosts.—*Clangula clangula, Marila marila, Netta rufina, Spatula clypeata, Nettion crecca, Chaulelasmus streperus, Anas rubripes, Anas platyrhynchos, Anas platyrhynchos domestica, Branta canadensis.*

Family ACOLEIDÆ (emended name).

Acoleinæ FUHRMANN, 1900.
"*Acoleinidæ*" FUHRMANN, 1907.

Family diagnosis.—Tænioidea: Scolex generally armed, seldom without rostellum. Suckers unarmed. Strobila thick, with short segments. Musculature consists of at least two layers of longitudinal muscles alternating with layers of transverse muscles. A single set, double set, or partial duplication of reproductive organs in each segment. Male genital openings marginal. Female genital (vaginal) openings lacking. Cirrus always very large and armed with strong hooks or spines. Egg with thin transparent shells. Adults in birds.

Type-genus.—*Acoleus* Fuhrmann, 1899.

Genus ACOLEUS Fuhrmann, 1899.

Generic diagnosis.—Acoleidæ: Scolex with armed rostellum. A single set of reproductive organs in each segment. Male genital pores regularly alternate. Cirrus pouch passes ventral of longitudinal excretory vessels and nerve. Testicles numerous. Vagina functions as a very large seminal receptacle. Adults in birds.

Type-species.—*Acoleus armatus* Fuhrmann, 1899 = *Acoleus vaginatus* (Rudolphi, 1819) Fuhrmann, 1900.

ACOLEUS VAGINATUS (Rudolphi, 1819) Fuhrmann, 1900.

For description see FUHRMANN, 1899e, pp. 620–622, figs. 4–6 (*A. armatus*); 1899g, pp. 347-350, pl. 17, figs. 10–14 (*A. armatus*); 1900c, pp. 369–370.

Host.—*Himantopus mexicanus.*

Genus GYROCŒLIA Fuhrmann, 1899.

Brochocephalus LINSTOW, 1906 (type, *B. paradoxus* LINSTOW, 1906; see Fuhrmann, 1908a, p. 86).

Generic diagnosis.—Acoleidæ: Rostellum armed with a single crown of hooks arranged in a zigzag row having eight angles. A single set of reproductive organs in each segment. Male pores irregularly alternate. Cirrus pouch passes between the longitudinal excretory vessels and dorsal of the nerve. Testicles few. Seminal receptacle very small. Uterus ring-like with numerous outpocketings and with an opening in gravid segments dorsally and ventrally. Adults in birds.

Type-species.—*Gyrocœlia perversus* Fuhrmann, 1899.

GYROCŒLIA PARADOXA (Linstow, 1906).

For description see LINSTOW, 1906, p. 183, pl. 2, figs. 36, 38; pl. 3, figs. 35, 37 (*Brochocephalus paradoxus*).[a]

Host.—*Ægialitis mongola.*

Genus DIPLOPHALLUS Fuhrmann, 1900.

Generic diagnosis.—Acoleidæ: A double set of male reproductive organs and a single set of female organs in each segment. Two vaginæ functioning as large seminal receptacles. Adults in birds.

Type-species.—*Diplophallus polymorphus* (Rudolphi, 1819, partim Krabbe, 1869) Fuhrmann, 1900.

DIPLOPHALLUS POLYMORPHUS (Rudolphi, 1819) Fuhrmann, 1900.

For description see KRABBE, 1869b, pp. 301–302, pl. 7, figs. 163, 164 (*Tænia polymorpha*).—WOLFFHÜGEL, 1900a, pp. 136–152, pl. 5, figs. 67–80, pl. 6, figs. 81–84 (*Tænia polymorpha*).—COHN, 1900c, pp. 277-288, pl. 15, figs. 19–22 (*Tænia polymorpha*).—FUHRMANN, 1900c, p. 371.

Host.—*Himantopus mexicanus.*

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[a] Fuhrmann (1908a, p. 86) examined the original material of *Brochocephalus paradoxus* and found that this species belongs in *Gyrocœlia* in spite of Linstow's different description.

Genus SHIPLEYA[a] Fuhrmann, 1907.

Generic diagnosis.—Acoleidæ: Scolex without rostellum, but with apical papilla. Single set of reproductive organs in each segment. Male genital pores regularly alternate. Cirrus conical in shape, armed with large hooks. Yolk gland dorsal of ovary. Vagina represented only by a small seminal receptacle in central portion of segment. Uterus at first ring shaped, later becomes much branched. Adults in birds.

Type-species.—Shipleya inermis Fuhrmann, 1907.

Genus DIOICOCESTUS Fuhrmann, 1900.

Generic diagnosis.—Acoleidæ: Diœcius, entire strobila male or female. Female thicker and broader than male. Male with a double set; female with a single set of reproductive organs in each segment. Irregularly alternating vagina reaches almost to the edge of the segment. Eggs with three envelopes. Adults in birds.

Type-species.—Dioicocestus paronai Fuhrmann, 1900.

DIOICOCESTUS ACOTYLUS Fuhrmann, 1904.

For description see FUHRMANN, 1904a, pp. 327-331; 1904b, pp. 131-148, pl. 10, figs. 2-11.

Host.—Colymbus dominicus.

DIOICOCESTUS PARONAI Fuhrmann, 1900.

For description see FUHRMANN, 1900c, pp. 363-366, figs. 1-3.

Host.—Plegadis guarauna.

Family AMABILIIDÆ (emended name).

"*Amabilinidæ*" FUHRMANN, 1907.

Family diagnosis.—Tænioidea: Scolex with armed rostellum; suckers usually unarmed. Segments with lateral appendages. A double or single set of reproductive organs in each segment. Male genital pores marginal. Vaginal opening lacking, replaced by the marginal, ventral, or dorsal opening of an accessory genital canal. Egg with thin transparent shells. Adults in birds.

Type-genus.—Amabilia Diamare, 1893.

Genus AMABILIA Diamare, 1893.

Aphanobothrium LINSTOW, 1906 (type, *A. catenatum* LINSTOW, 1906; see FUHRMANN, 1908a, p. 88).

Generic diagnosis.—Amabiliidæ: Scolex very small with armed rostellum. A double set of male reproductive organs in each segment, with two pores, one on either side of the segment. Cirrus

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[a] This genus and its type-species mentioned by Fuhrmann in 1907 (1907a, p. 294), were described by him in 1908 (1908b, p. 70).

armed with strong spines. Testicles numerous, in median field. Female organs median, a single set in each segment. Uterus forming a cage-like meshwork consisting (Fuhrmann, 1908a, p. 88) of a dorso-ventral ring with dorso-ventral anastomoses. Accessory vagina opening ventrally, communicating (?) with a canal from the excretory system opening in the ventral surface of the segment in the median line. Adults in birds.

Type-species.—*Amabilia lamelligera* (Owen, 1832) Diamare, 1893

Genus SCHISTOTÆNIA Cohn, 1900.

Generic diagnosis.—Amabiliidæ: Scolex with very large, armed rostellum. A single set of reproductive organs in each segment. Male genital pores irregularly alternate. Male deferent canal passes between the longitudinal excretory vessels. Testicles numerous, extending across the entire width of the segment. Vagina absent. Vaginal functions performed by a median, dorso-ventral canal (accessory vagina) opening on the surface of the segment dorsally and ventrally. Adults in birds.

Type-species.—*Schistotænia macrorhyncha* (Rudolphi, 1810) Cohn, 1900 = *Schistotænia scolopendra* (Diesing, 1850). (See Fuhrmann, 1907b, p. 534.)

SCHISTOTÆNIA MACRORHYNCHA (Rudolphi, 1810) Cohn, 1900.

For description see KRABBE, 1869b, p. 305, pl. 7, fig. 172 (*Tænia macrorhyncha*).—COHN, 1900c, pp. 265–277, pl. 14, figs. 8–18 (*S. macrorhyncha* and *S. scolopendra*).—CLERC, 1907, pp. 704–708, pl. 1, figs. 3–7.

Hosts.—*Colymbus dominicus*, *Colymbus auritus*.

Genus TATRIA Kowalewski, 1904.

Generic diagnosis.—Amabiliidæ: Rostellum with a single crown of few large hooks at apex and with numerous rows of small spine-like hooks behind the crown of large hooks. Suckers and posterior portion of head covered with minute spines. Segments not numerous (about 30). A single set of reproductive organs in each segment. Male genital pores regularly alternate. Cirrus pouch large. Testicles not numerous (7 in the type species). Male and female canals pass between the longitudinal excretory vessels. Distal end of vagina instead of opening to the exterior turns backward into the next following segment and opens into the seminal receptacle of that segment. Seminal receptacles in median line of strobila. An accessory vagina present in the opposite side of the segment from the cirrus pouch, sometimes with an opening in the margin of the segment. Adults in birds.

Type-species.—*Tatria biremis* Kowalewski, 1904.

TATRIA APPENDICULATA Fuhrmann, 1908.
For description see FUHRMANN, 1908b, p. 69, figs. 56, 57.

Host.—*Colymbus dominicus.*

TATRIA BIREMIS Kowalewski, 1904.
For description see KOWALEWSKI, 1904c, pp. 284–304, pls. 5–6, figs. 1–21; 1904e, pp. 367–369, pl. 9, figs. 1–10; pl. 10, figs. 11–21.

Host.—*Colymbus auritus.*

Family FIMBRIARIIDÆ Wolffhügel, 1898.

Family diagnosis.—Tænioidea: Scolex small, unstable, and frequently lost, with rostellum armed with a single row of hooks. Large pseudo-scolex. Strobila without segments, but with transverse grooves which produce an appearance of segmentation. Three pairs of longitudinal excretory vessels. Reproductive organs not segmentally arranged. Genital pores marginal, most of them opening on the same side of the segment. Testicles numerous, arranged in transverse rows. Uterus not persistent, breaking down into a large number of egg sacs. Egg with thin transparent shells. Adults in birds.

Type-genus.—*Fimbriaria* Frölich, 1802.

Genus FIMBRIARIA Frölich, 1802.

Epision LINTON, 1892 (type, *Epision plicatus* LINTON, 1892).
Notobothrium LINSTOW, 1905 (type, *Notobothrium arcticum* LINSTOW, 1905= *Fimbriaria fasciolaris* PALLAS; see FUHRMANN, 1908a, p. 90).

Generic diagnosis.—Fimbriariidæ: With the characters of the family.

Type-species.—*Fimbriaria malleus* Frölich, 1802 = *Fimbriaria fasciolaris* (Pallas, 1781) Wolffhügel, 1899.

FIMBRIARIA FASCIOLARIS (Pallas, 1781) Wolffhügel, 1899.
For description see WOLFFHÜGEL, 1900a, pp. 67–135, figs. 1–66.

Hosts.—*Mergus serrator, Oidemia americana, Oidemia fusca, Somateria mollissima, Harelda hyemalis, Clangula clangula, Marila marila, Netta rufina, Cairina moschata domestica, Spatula clypeata, Nettion crecca, Mareca penelope, Anas platyrhynchos, Anas platyrhynchos domestica, Anser anser domesticus, ?Gallus gallus domesticus.*

FIMBRIARIA PLANA Linstow, 1905.
For description see LINSTOW, 1905t, pp. 362–365, pl. 23, figs. 10–14.

Host.—*Anas platyrhynchos.*

GENERA IMPERFECTLY KNOWN.

Genus TETRACISDICOTYLA Fuhrmann, 1907.

Generic diagnosis.—Tænioidea: Scolex relatively large, without rostellum. In the posterior portion of each sucker a peculiar muscular organ simulating a pair of smaller suckers. Neck absent. Segmentation of the strobila indistinct. A single set of reproductive organs in each segment. Genital pores marginal, irregularly alternating. Cirrus pouch large. Vas deferens coiled. Testicles numerous. Vagina opens into the genital pore in front of cirrus pouch. Adults in birds.

Type-species.—*Tetracisdicotyla macroscolecina* Fuhrmann, 1907.

TETRACISDICOTYLA MACROSCOLECINA Fuhrmann, 1907.

For description see Fuhrmann, 1907b, pp. 535-536, fig. 43.

Host.—*Butorides virescens.*

Genus COPESOMA Sinitsin, 1896.

Generic diagnosis.—Tænioidea: Scolex with large rostellum. Genital pores irregularly alternate, in young segments ventral, in gravid segments marginal. Adults in birds.

Type-species.—*Copesoma papillosum* Sinitsin, 1896.

COPESOMA PAPILLOSUM Sinitsin, 1896.

For description see Fuhrmann, 1901a, p. 761.

Host.—*?Pisobia damacensis.*

IMPERFECTLY KNOWN SPECIES.

TÆNIA COLLICULORUM Krabbe, 1869.

For description see Krabbe, 1869b, p. 330, pl. 9, fig. 259.

Host.—*Riparia riparia.*

TÆNIA CONICA[a] Molin, 1858.

For description see Molin, 1861c, pp. 253-254, pl. 7, figs. 1, 2.—Stiles, 1896f, pl. 3, figs. 35, 36.

Host.—*Anas platyrhynchos.*

TÆNIA DISTINCTA Lönnberg, 1889.

For description see Lönnberg, 1889a, pp. 12-13, figs. 3, 4.

Host.—*Larus canus.*

TÆNIA FILUM[b] Goeze of Linton, 1892.

For description see Linton, 1892l, pp. 106-107, pl. 8, figs. 72-78.

Host.—*Larus californicus.*

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[a] Part of Molin's original (Bureau of Animal Industry, No. 1390) shows the long, prominent rostellum, with marks indicating that at one time there were 10 hooks present.

[b] According to Fuhrmann (1908a, p. 126) this form is probably a *Hymenolepis*, possibly *H. fusus.*

TÆNIA LEUCKARTI Krabbe, 1869.

For description see Krabbe, 1869b, p. 337, pl. 10, figs. 268, 269.

Host.—Ardea cinerea.

TÆNIA MACROCANTHA Linton, 1892.

For description see Linton, 1892l, p. 107, pl. 8, figs. 79-82.

Host.—Oidemia americana.

TÆNIA MEGALORHYNCHA Krabbe, 1869.

For description see Krabbe, 1869b, p. 284, pl. 5, figs. 104, 105.

Host.—Arquatella maritima.

TÆNIA MUSCICAPÆ Linstow.

Mentioned by Fuhrmann, 1908a, pp. 96, 173, 182.

Host.—Motacilla alba.

TÆNIA ODIOSA Leidy, 1887.

For description see Leidy, 1887a, pp. 5-6, figs. 9-11; 1904a, pp. 202-203, figs. 9-11.

Host.—Colinus virginianus.

TÆNIA OPORORNIS Leidy, 1887.

For description see Leidy, 1887a, pp. 9-10, figs. 23-25; 1904a, pp. 206-207, figs. 23-25.

Host.—Oporornis formosa.

TÆNIA PESTIFERA Leidy, 1855.

For description see Leidy, 1855a, p. 443; 1887a, pp. 3-4, figs. 2-4; 1904a, pp. 76, 201, figs. 2-4.

Hosts.—Icteria virens, Dolichonyx oryzivorus.

TÆNIA PLATYCEPHALA Rudolphi, 1810.

For description see Rudolphi, 1810a, p. 94; 1819a, p. 508.

Hosts.—Alauda arvensis, Saxicola œnanthe, Anthus pratensis.

TÆNIA SIMPLA Leidy, 1887.

For description see Leidy, 1887a, p. 8, fig. 18; 1904a, p. 205, fig. 18.

Host.—Antrostomus carolinensis.

TÆNIA STRIGIS-ACADICÆ Leidy, 1855.

For description see Leidy, 1855a, p. 444; 1904a, p. 76.

Host.—Cryptoglaux acadica.

TÆNIA TETRABOTHRIOIDES Lönnberg, 1890.

For description see Lönnberg, 1890b, pp. 13-15.

Host.—Pelidna alpina.

TÆNIA URNIGERA Leidy, 1887.

For description see Leidy, 1887a, pp. 4-5, figs. 5-8; 1904a, p. 202, figs. 5-8.

Host.—Molothrus ater.

TÆNIA VEXATA Leidy, 1887.

For description see Leidy, 1887a, pp. 7-8, figs. 15, 16; 1904a, p. 204, figs. 15,16.

Host.—Phlœotomus pileatus.

TÆNIA VIATOR Leidy, 1887.

For description see Leidy, 1887a, pp. 6-7, figs. 12-14; 1904a, p. 203, figs. 12, 14.

Host.—Elanoides forficatus.

COMPENDIUM OF SPECIES PARASITIC IN NORTH AMERICAN BIRDS ARRANGED ACCORDING TO HOSTS.

The scientific names of hosts have been selected for me by Mr. H. C. Oberholser, of the Bureau of Biological Survey, U. S. Department of Agriculture.

Species of tapeworms collected in this country of which I have examined specimens are indicated by an asterisk, and the names of the hosts in which they were found are similarly marked.

COLYMBIFORMES.

Gavia stellata (Pontoppidan).
Tetrabothrius macrocephalus, p. 60.
Hymenolepis capillaris, p. 91.
rostellata, p. 96.

Gavia arctica (Linnæus).
Tetrabothrius macrocephalus, p. 60.
Hymenolepis capillaris, p. 91.
rostellata, p. 96.

Gavia immer (Brünnich).
Tetrabothrius macrocephalus, p. 60.
Hymenolepis capillaris, p. 91.
rostellata, p. 96.

Colymbus dominicus[a] Linnæus.
Choanotænia bilateralis, p. 75.
Hymenolepis capillaroides, p. 91.
Dioicocestus acotylus, p. 103.
Schistotænia macrorhyncha, p. 104.
Tatria appendiculata, p. 105.

Colymbus auritus Linnæus.
Tetrabothrius macrocephalus, p. 60.
Hymenolepis capillaris, p. 91.
furcifera, p. 93.
podicipina, p. 96.
Schistotænia macrorhyncha, p. 104.
Tatria biremis, p. 105.

PROCELLARIIFORMES.

Puffinus puffinus (Brünnich).
Tetrabothrius heteroclitus, p. 60.

Puffinus kuhli[b] (Boie).
Tetrabothrius heteroclitus, p. 60.

Priocella glacialoides (Smith).
Tetrabothrius heteroclitus, p. 60.

Daption capensis (Linnæus).
Tetrabothrius heteroclitus, p. 60.

Fulmarus glacialis (Linnæus).
Tetrabothrius monticellii, p. 60.

Diomedea exulans Linnæus.
Tetrabothrius diomedeæ, p. 60.
heteroclitus, p. 60.
umbrella, p. 61.

Diomedea albatrus Pallas.
Tetrabothrius heteroclitus, p. 60.
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[a] The typical form, *C. dominicus dominicus* is South American; *C. dominicus brachypterus* Chapman is the North American form.

[b] Hypothetical North American form.

[c] The typical form is European; the North American form is *N. nycticorax nævius* (Boddaert).

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[a] The typical form occurs only in the Old World; the North American form is *Somateria mollissima borealis* Brehm.

[b] The typical form occurs only in the Old World; *C. clangula americana* Bonaparte is the North American form.

[c] In its natural state this species occurs only in South America, but is domesticated in the United States.

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[a] The typical form occurs only in the Old World; the North American form is *B. bernicla glaucogastra* (Brehm).

[b] In its natural state this species occurs only in the Old World, but is domesticated in the United States.

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[a] In its natural state this species occurs only in the Old World, but is domesticated in the United States.

[b] The typical form occurs only in the Old World; the North American form is *F. peregrinus anatum* Bonaparte.

[c] Domesticated in North America.

[d] Introduced in North America.

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[a] Fuhrmann (1908a, p. 118) lists this species as a parasite of *P. damacensis*, a possible error. Stossich (1892 b) described *Tænia vallei* as a parasite of *Tringa minuta*, but Fuhrmann has not listed it under the latter host.

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[a] In its natural state this species occurs only in the Old World.

[b] The typical form is South American; the North American form is *T. melancholicus couchi* Baird.

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[a] The typical form is confined to the Old World; the North American form is *Pica pica hudsonia* (Sabine).

[b] The typical form occursonly in the Old World; two North American forms are recognized, *C. corax principalis* Ridgway (northern), and *C. corax sinuatus* Wagler (southern).

[c] Introduced in North America.

[d] The typical form occurs only in the Old World; the North American form is *L. curvirostra minor* (Brehm).

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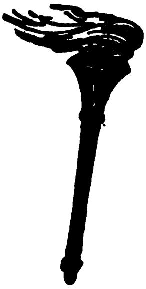

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